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INTRODUCTION

FORESTRY, in common with other sciences, has developed an extensive literature in many languages, and the need for a central clearing-house for current publications has been realized by forest officers of the Empire for some time. As early as 1920 the Empire Forestry Conference in London unanimously approved a proposal to set up a bureau at the Imperial Forestry Institute. Owing to financial difficulties the project had to be postponed, but was raised again at each of the three subsequent Conferences and by the Imperial Committee on Economic Consultation and Co-operation in 1933. As a result of these discussions some contributions were made towards the cost of establishing a bureau. These funds enabled the Director of the Imperial Forestry Institute, Mr. J. N. Oliphant, to bring out the *Current Monthly Record*, a monthly mimeographed list of titles of current literature. This was followed in 1936 by the *News Bulletin of Empire Forest Departments*, also in mimeograph.

It had always been recognized that the most important function of a bureau would be the publication of abstracts, but this had proved quite impossible with the funds available. Indeed, the production of the two periodicals mentioned above made considerable demands on the time of the staff of the Institute. During this time, however, a development had occurred that made it possible to view the problem from an entirely different angle.

On the recommendation of the Imperial Agricultural Research Conference of 1927 the organization of the Imperial Agricultural Bureaux was established and financed from a common fund contributed by Empire Governments in agreed proportions. Under the authority of a Central Council in London, eight bureaux were established 'to collect, collate, and disseminate information on research in eight selected branches of agricultural science. . . .' The Bureaux are concerned with Soil Science, Animal Health, Animal Nutrition, Animal Breeding and Genetics, Plant Breeding and Genetics, Pastures and Forage Crops, Horticulture and Plantation Crops, and Agricultural Parasitology [Helminthology]. The Imperial Entomological Institute and the Imperial Mycological Institute, both of which had been in existence for some years previous to this development, also became part of the organization. In 1938 an Imperial Bureau of Dairy Science was added.

At the British Commonwealth Scientific Conference, held in London in 1936, it was proposed that an Imperial Forestry Bureau should be set up as a member of this organization. The urgent need for such a step was emphasized, and it was suggested that the Executive Council should give immediate consideration to a suitable location for this Bureau. The outcome was the establishment of the Imperial Forestry Bureau at Oxford in 1938, as a member of the group of Imperial Agricultural Bureaux and affiliated with the Imperial Forestry Institute. The Imperial Forestry Bureau and the Imperial Forestry Institute are thus separate organizations, each with its own finances, though, to secure co-operation, the Professor of Forestry is *ex officio* Director of the Bureau. Their juxtaposition may be regarded as a true symbiosis; on the one hand the work of the Bureau is of great use to the Institute, and on the other the facilities of the Institute library service and the technical advice of the members of the Institute staff represent an asset of very considerable value to the Bureau.

Thanks to the initiative of Mr. J. N. Oliphant, and to the co-operation of members of his staff, the Bureau was soon organized and work started. The reviewing and abstracting of current literature began towards the end of 1938, and the first number of *Forestry Abstracts* was published in June 1939.

In common with other members of the Bureaux' organization, the object of the Imperial Forestry Bureau is to serve research officers in all the countries of the British Commonwealth. Each country of the Empire contributes to the common fund and each country has an equal share in the services that the Bureau is able to offer. With this object in view the Bureau proposes (*a*) to publish *Forestry Abstracts* quarterly; (*b*) to answer technical inquiries and supply references to literature as required and as facilities permit; (*c*) to publish periodical 'Communications' on important subjects of current interest, reviewing the important and recent literature of a particular subject, supported by a fairly complete bibliography; (*d*) to collect reprints of papers on basic research, for loan to any one desiring them; (*e*) if the demand is great enough, to develop a translating and duplicating service for supplying copies in English of important papers that are either in a foreign language or are relatively inaccessible; (*f*) in co-operation with the Imperial Forestry Institute to edit and distribute the *News Bulletin of Empire Forest Departments*.

The potential value of these services, particularly of the abstracts, to the research worker is self-evident, but it is hoped to reach a much wider field and to enable every active forester, if he so wishes, to keep up to date with progress in forestry the world over. The extent to which this will be possible, and indeed the development of the Bureau in general, will depend directly on the use that is made of the services offered.

FORESTRY ABSTRACTS

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THE RELATION OF TSETSE-FLY CONTROL TO FORESTRY

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'In these circumstances forestry departments are becoming more and more involved in the study of general problems of rural development and land use, and contacts between them and other departments engaged on similar work have been strengthened. There is room, however, for more co-operation and the example set by certain dependencies in organizing a concerted attack on rural problems by the departments concerned with the use of the land should be helpful in promoting this.' [Parliamentary White Paper. *The Colonial Empire*, 1939.]

The object of this article is to summarize the results of experimental and research work which has been in progress in the East and West African colonies from about 1930 to 1937, particularly in Tanganyika and Nigeria. A list of the publications consulted is given at the end of this paper, the chief of these being the comprehensive work compiled by the late C. F. M. Swynnerton just before his tragic death.

The importance of the subject can be realized when it is stated that the greater part of Tropical Africa, some four and a half million square miles in a band nearly 2,000 miles wide, is infested by one or more of the twenty-one known species of tsetse fly. The British African colonies and protectorates affected are Gambia, Sierra Leone, Gold Coast, Nigeria, Tanganyika, Kenya, Uganda, Northern Rhodesia, and Nyasaland. In Tanganyika alone about two-thirds of the country are fly-infested and to such an extent that vast areas are uninhabitable. In addition, owing to the mass advances of the fly, territory is continually being lost to the native populations. Of particular significance to foresters is that one of the principal methods of attack by the Sleeping Sickness Services is the clearing or treatment of woody vegetation, a procedure which is bound to affect forest policy both as regards protection and production.

It is true that in the past the tsetse flies have performed an invaluable service, saving great areas of country from becoming peopled, exhausted, and ruined, but, since economic development is one of the British colonial aims, the mere locking up of these regions cannot be regarded as a wise use of the forest. Under measures of tsetse control, land reclamation and movements of population are proceeding and involve enormous clearings of vegetation that is largely forest.

As far back as 1919 Swynnerton stated in one of his reports that 'the practical study of the tsetse is a matter for the botanist and ecologist rather than the unaided entomologist', and he continues seventeen years later to reiterate this statement and to add that this view 'has been amply borne out by experience'.

To illustrate the problem, a brief description is given of the habitat of one of the common species of tsetse fly, *Glossina morsitans*, which is very widespread in East and West Africa, together with a short account of the indirect methods of attack by vegetational treatment. Research on these lines has been undertaken to a larger extent in East Africa, particularly in Tanganyika, where the need has been greater and where until a few years ago staff and funds were more available.

The species of tsetse fly, *Glossina morsitans*, is a most efficient carrier both of Nagana (the sleeping sickness disease of animals) and of the most virulent form of sleeping sickness in man, *Trypanosoma rhodesiense*. It is absent from Somaliland, Kenya Colony, and Zululand, but is of importance in that part of the Sudan extending towards West Africa. In Tanganyika it infests half the colony and is present in Nyasaland, Portuguese East Africa, Northern and Southern Rhodesia, Uganda, Belgian Congo, and Bechuanaland. It excludes cattle from most of the areas it inhabits and is one of the most dangerous species to man. 'No tsetse', writes Swynnerton, 'is of greater importance and of none have the studies of our Tsetse Research Department in Tanganyika been so full'. It is essentially a 'savanna-game' fly, and its typical home is the *Isoberlinia-Brachystegia* savanna type of woodland,

known in Tanganyika as 'Miombo' bush, which is found widely represented in the north-western and south-eastern parts of the colony.

It is now established that all species of tsetse need, for full development, more than one vegetational type, either seasonally or sometimes even almost daily. For example, they may require feeding grounds, rest-haunts (where they remain after feeding or during bad weather conditions), mating-grounds, and breeding-grounds (where suitable conditions obtain for oviposition and for development of the pupae). Generally speaking, well-drained open woodland is needed when the rains are severe and humidity high, and dense cover when desiccation is great. The range of tolerable conditions varies with the species concerned. Some species require separate grounds for each phase of their development while, for others, one type of cover will serve for two or more or even all purposes. It is therefore obvious that the conditions most suitable for tsetse flies are along the contacts of differing vegetational types, or (as in the case of *Glossina palpalis*) where water and two vegetational types meet. It is therefore the aim of the Sleeping Sickness Service Staffs to remove, or modify, one of these desiderata during the critical season of the year with a minimum of expenditure. It is for this reason that a study of vegetation types is so important in tsetse work.

The species of fly we are considering at the moment, *G. morsitans*, cannot inhabit the following types of bush:

i. Dry thorn bush, unless it exists as patches or strips in 'Miombo'.
ii. Rain forest or dense evergreen woodland.
iii. Extensive deciduous closed thicket.
iv. Open grass-covered plains, seasonally swampy, known in Tanganyika as 'Mbugas'.
v. Large areas of certain types of 'Miombo'.

This immunity is considered to be due to homogeneity of vegetation.

The fly occurs at elevations from sea-level to 5,500 feet with a wide range of temperature; at the highest elevations the temperature approaches within two or three degrees of freezing-point. In all tsetse research it is a knowledge of the eco-climates (climates of the fly refuges) rather than the standard climates that is required in order to discover the actual conditions under which the particular fly lives.

Experiments have been conducted by T. A. M. Nash to show the extent to which this species of fly utilizes different habitats. Based on the average number of flies caught per 10,000 yards per 'fly-round' over a period of four years, the results obtained were as follows:

Brachystegia microphylla	560 flies
Acacia usambarensis	230 „
Isoberlinia globiflora	180 „
Tree *Combretum-Terminalia* savanna	180 „
Acacia spirocarpa	70 „
A. campylacantha and *A. xanthophloea* surrounding a moist thicket	40 „
Clearings round settlement	30 „
Open 'Mbuga' with a few gall-acacias	30 „
Gall-acacias thickened by *A. senegal* or *Commiphora spp.*	20 „
Cultivated land in the fly belt	4 „

J. F. V. Phillips and T. A. M. Nash have carried out experiments, in all the chief types of vegetation inhabited by *G. morsitans*, in Tanganyika on the importance of temperature, humidity, solar radiation, sunshine incidence, light, and rain, in grass-burned and unburnt plots, combined with an examination of the soil factors including temperature, water-content, water-supplying power, permeability, porosity, organic content, acidity, maximum water-containing capacity, hygroscopic coefficient, maximum shrinkage, and colloid content. These experiments established the manner in which the typical 'Miombo' vegetation, rather than other types, favours *G. morsitans*.

Typical 'Miombo' bush usually occupies rises and slopes, underlain with granites and gneisses, and the annual rainfall varies from 27 to 50 in. It consists of slender trees from 30 to 60 ft. high, with small-leaved spreading storeys of flat foliage, mostly in the upper third of the trees' height, shading a poor ground stratum of grass. The dominant growth consists of species of *Isoberlinia* and *Brachystegia* mixed with various other genera, most of them possessing furrowed bark where the female flies can safely hide. Hollows at the bases of the trees, and fallen branches and stems, form the requisite shelter from desiccation. The soil is powdery, and this, coupled with humus in rot-holes, provides suitable ground where the larvae can pupate. The tendency of each principal tree species

of a consociation to come into leaf at a different time and the type of lower-story vegetation present affords sufficient varied environment for the development of the tsetse. The rest-haunts and breeding-grounds of *G. morsitans* are provided by the 'Miombo', and the feeding-grounds are supplied by roads, paths, glades, or edges of open plains where man and game tend to pass. Where the vegetation merges on the one hand into rain forest and on the other into dry thorn bush, the latter is penetrated by flies to some extent.

The most natural form of control which first suggested itself to early pioneers was the wholesale clearing of infested sites, but as Swynnerton remarked, such a method 'may conduce to ease of administration, but is a lamentable event', and it was soon decided that such a course, except in certain limited cases, was not only expensive and wasteful but also unnecessary. This practice was therefore abandoned and replaced by barrier clearings in which boundary strips of adequate width were entirely denuded of all woody vegetation, in order to isolate tsetse areas, which were then attacked in other ways in conformity with a definite plan.

With regard to these barrier clearings, some of Swynnerton's conclusions were as follows:

Road clearings.

i. A clearing intended merely to protect a road and not to act as a barrier should be at least 800 yards broad, or, better, 1,000 yards, with the road generally running down its centre.
ii. The clearing should be carefully supervised to ensure (*a*) that the width is duly increased where the bush is more visible through concavity of the ground in between, and (*b*) a minimum of regrowth, and the clearance of all trees.

Broader cleared barriers.

i. In the case of *G. morsitans* settlement of the land is likely to be useful.
ii. In the case of *G. swynnertoni* the reverse seems to be the case. If settlement be present, a width of clearing of several miles will, without extra precaution, be necessary for real safety, if the fly is dense up to the edge of the clearing.
iii. Extra precaution should take the form of the employment of 'pickets' and seeing that they do their work; with this provision a 2-mile clearing might suffice.
iv. The clearing must be quite clean.

Having made efficient barriers, a plan was then required to attack the isolated infested bush, beginning at the margins. Since each tsetse is dependent on obtaining access to two or three types of bush, control will probably consist of modifying the whole or part of one type of bush only, that is, the adoption of a system of discriminative clearings. One form of discriminative clearing consists of cutting the scattered thicket and burning the grass, leaving any trees untouched. Discriminative clearings entailing the minimum effective modification of the vegetation can only be decided upon as a result of long observation and practice; in order that no risks be taken, and to err on the side of safety, discriminative clearings of a less exact nature are undertaken at present on most of the areas, according to what is known of the habits of the particular flies concerned. As time goes on and more information becomes available, finer distinctions will be made, resulting in less destruction of woodland. Many experiments have been inaugurated to discover the types of vegetation that were unsuited to each species of fly. When such areas were found, barriers were made between them and the main infested bush. In Tanganyika this method has been found successful with certain species of fly.

The most interesting method of control, and one that has brought a certain relief to many anxious foresters, is that which aims at increasing the density of the vegetation. This form of attack shows great promise in various parts of Tanganyika, and a short account of the origin of the method will help to illustrate how the practice has developed.

It was observed by Swynnerton and others that fly advance did not proceed beyond a certain large area of natural thicket some 2,400 square miles in extent in the vicinity of Itigi in Tanganyika and known as Itigi bush. In consequence it was decided to investigate this type of woodland and to conduct a series of experiments to discover the exact conditions in this natural barrier, with the object of reproducing them elsewhere.

The Itigi thicket was found to consist mainly of the *Burttia-Baphia* type of vegetation, confined to a light yellow clay cement or duricrust, covering the old granite peneplain of that locality. Wherever

erosion has eaten through the duricrust to the granite below, the thicket has disappeared and 'Miombo' (*Isoberlinia-Brachystegia*) has replaced it. The bush is distinguished by the absence of lianes and the presence of *Burttia prunoides*, *Bussia massaiensis*, *Pseudoprosopis fischeri*, *Combretum trothae*, *Grewia burttii*, *Baphia massaiensis*, *Baphia burttii*, and *Craibia burttii*. Only the last is a tree, evergreen and gregarious. Most of the shrubs are broad-based and many-stemmed. There are two distinct plant associations, one (characterized more strongly by Rubiaceae) being denser and lower than the other, which mainly occupies the crests. The whole presents an appearance of being a level-topped homogeneous thicket. During the season of leaf there is dense shade, but in the dry season it becomes a fine-twigged thicket which allows the sun to penetrate but excludes the wind and so becomes very hot; at the same time it contains innumerable crevices which would provide shelter for insects. At all times the lower stratum is open. In addition, game, which would be suitable food for the tsetse, is plentiful. In spite of this, observation proved that the fly did not advance *through* this thicket, and from experiments the following conclusions were drawn:

i. It was strongly indicated that the fly entered the thicket to a distance of at least 50 yards uncarried by animals. They also penetrate in extremely small numbers to a distance of 1 mile, though whether aided by animals or not is unknown.
ii. Animals are probably largely responsible for the flies that were found in the thicket; it is notable that the flies were not found there when the thicket was in leaf.
iii. Flies pass into but not over the thicket.
iv. Flies were found on the paths in far greater numbers than off them.

The general conclusions were that the Itigi type thicket when leafless admits flies in small numbers all the time. The penetration to 900 yards as compared with that to 50 yards was 0·3 to 7 per cent. of the numbers in the savanna outside, so it is probable that with greater depth the limit of penetration for all practical purposes would soon be reached. When the thicket was in leaf practically no flies could be caught in it. Although it cannot be said that a mile's width of deciduous thicket will definitely exclude all *G. morsitans*, in practice, however, where exclusion of grass fires will produce strong densification, it is nearly as cheap to create a barrier 2 or 3 miles in width as one of 500 yards. These experiments indicate that evergreen thicket, in dry country, is likely to exclude types of tsetse such as *G. morsitans* and much attention has been given to the artificial formation of barrier thickets by the exclusion of fire, assisted by planting where necessary.

It is clear that where natural effective thicket can be produced merely by excluding fires, planting will not be necessary, but there are many patches or types of country where fire exclusion is impracticable, yet planting may be undertaken with success. The need for cheap transport and for low nursery and transplanting costs cause preference to be given to those species that will grow from seed over those grown from cuttings, unless the latter are obtainable in quantity locally. Considerable success has been obtained with cuttings at Shinyanga, in Tanganyika, with Manyara (*Euphorbia tirucalli*) which can only be successfully established in this manner. These cuttings produced a dense evergreen thicket in a few years. They were planted in rows 12 ft. apart to permit weeding with a plough, as this plant is easily suppressed by grass in its early years. In specially unsuitable ground, such as areas that are flooded or contain hard pan, natural indigenous species were used to fill the gaps. Observations showed that in a barrier 100 yards wide there were 77·2 flies per 10,000 yards on the infested side and only 9 flies on the protected side. It is reasonable to assume that wider barriers, added to further progress in densification, will be very effective.

Among the species being tried with success are *Melia azedarach*, *Cassia siamea*, and *Dodonaea viscosa*, all of which are doing excellently. It is interesting to note that all three of these exotic species are being grown with great success in various parts of West Africa. Experiments with species of Eucalypts, Pines, and Cypresses were carried out by St. Clair Thompson on three of the most common soils, namely, sandy soils, hard pan, and black alluvial. The results were naturally most successful on the alluvial soil; but by varying the species and the method of establishment, promising results are being obtained on the other two soils. On the sandy granite areas the following species did well: *Manihot glaziovii* (Ceara rubber), *Schinus molle*, *Melia azedarach*, *Moringa pterygosperma*, *Cassia siamea*, *Lycium horridum*, and *Rhus glaucescens*. Thorny climbers such as species of *Combretum*, *Bougainvillea*, *Harrisonia*, *Acacia*, and *Caesalpinia* are interplanted with the erect trees to increase density.

On the hard-pan soils where most species had failed, success was obtained by ridge-planting

Ceara rubber, *Euphorbia tirucalli* and *Cassia siamea*, mixed with indigenous species, such as *Commiphora schimperi*, *Lannea humilis*, and suitable climbers like *Combretum* and *Harrisonia*, which grow naturally on these soils. The failure of the Eucalypts, which often thrived well for the first few years, was due chiefly to termites. *Callitris*, *Pinus*, and *Cupressus* were unable to withstand the adverse conditions. The Ceara and the *Euphorbia* were considered to be the most suitable; the first tolerates hard-pan conditions, can be sown *in situ*, regenerates early and well, disperses its seed widely, and forms thicket; the second makes good growth from cuttings in drought and its dense evergreen foliage makes good fly-barrier conditions. *Cassia siamea* is moderately suitable, but a little too clean-stemmed for thicket formation and would require a depth of some miles to be effective.

Experiments on these lines in the 'Miombo' country to control *G. morsitans* showed that Eucalypts were too liable in the later stages to large-scale destruction by termites; *Cassia didymobotrya* and *Dodonaea viscosa* appeared to be too short-lived; but *Harrisonia* was excellent. *Cassia siamea* did well but failed to produce a thicket growth. *Cupressus arizonica*, *Callitris robusta*, and *C. calcarata* grew excellently in spite of competition from grass and should make a very fine tsetse barrier.

Compared with exotics, indigenous species have the disadvantage of a slow rate of growth, owing to their habit of developing thick roots as an insurance against fires and drought; but in areas where these plants are already established this drawback does not apply. Dealing with the question of barriers of economic species, probably any close-timbered plantation, for example of Eucalypts, *Cassia*, conifers, &c., would form a good fly-barrier if sufficiently wide, as *G. morsitans*, and probably other species of fly, do not favour homogeneous woodland. There seems to be no reason why such barriers, in the vicinity of markets, could not be exploited by some method of strip felling. This problem still requires investigation and is one that calls for co-operation between the Sleeping Sickness Services and Forestry Departments.

Whether a section of country needs and is suitable for natural thicket barriers is a matter to be determined by those with a thorough knowledge of both the fly problem and the plants and their ecology. Broadly speaking, research in Tanganyika indicates that thorn country (*Acacia-Commiphora*), except on swamps and pan, changes to thicket more readily than 'Miombo' (*Isoberlinia-Brachystegia*), although in the moister localities of the latter, thicket forms easily though slowly. It must again be emphasized that much depends on the species of fly. For example, the effect of a barrier $2\frac{1}{2}$ miles long, composed of $\frac{3}{4}$ mile of deciduous thicket and $1\frac{3}{4}$ miles of evergreen thicket of Manyara (*Euphorbia tirucalli*), in protecting a road parallel to the barrier was as follows: Observations over a period of five years showed that in the case of *G. swynnertoni* the road had only 11·59 per cent. of the number of flies caught on the unprotected side, while in the case of another species of fly, *G. pallidipes*, twice as many were found.

In order to guard against drawing general conclusions from the above account of experience in East Africa, it is important to give the views of Nash, who worked in East Africa, and is now a member of the Sleeping Sickness Service in West Africa [Nigeria]. In his publication *The Probable Effect of Densification of Woodland upon the Distribution of Tsetse in Northern Nigeria* he points out that a large-scale policy of densification of woodland by fire exclusion would be beneficial to the tsetse flies in Northern Nigeria, enabling all the three common species (*G. morsitans*, *G. tachinoides*, and *G. palpalis*) to extend their range, owing to the greater protection against adverse climatic conditions afforded by thicker vegetation. He goes so far as to say that it would be most inadvisable to practise fire exclusion in the belts of country infested by *G. morsitans*. This is most probably due to the difference between the general climate of Northern Nigeria and Tanganyika. These parts of Nigeria have a comparatively long wet season of about 6 months from May to October and an average annual rainfall of approximately 35 to 45 in., and a long continuous dry season of 6 months, when heat and desiccation are very severe, particularly during the Harmattan wind from mid-December to mid-February. During most of this period the conditions in the so-called Doka bush (*Isoberlinia doka*, *I. dalziellii*), infested by *G. morsitans*, are so adverse to the fly that a large number succumb and the survivors take refuge in thicket patches and riverine woodland. In Tanganyika, although the average annual rainfall in similarly infested belts is much the same, its distribution is different. A rainy season from November to January is followed by a short dry season (February), which in turn is followed by a second rainy season (late February–May) and a long dry season from June to October. These conditions are much less intolerable and the fly remains undisturbed for the greater part of the year: although it is impossible to keep cattle in such areas in Tanganyika, numerous herds are

maintained in the corresponding areas in Northern Nigeria. However, Nash points out that complete clearing may not be essential in West Africa as the small difference of temperature produced by a slight modification of vegetation would be sufficient to cause mortality amongst the species *G. morsitans* and *G. tachinoides*. He illustrates this point with experiments in progress in Nigeria. The removal of the surrounding and intrusive growth of *Dichrostachys platycarpa* from sheltering Kurumis (riverine woodland), with the consequent penetration of sun and wind, may produce a critical temperature. He expresses the opinion that 'there are no real obstacles between a policy of conservation of woodland and tsetse control providing that due care is taken in the siting of forestry reserves and fuel plantations' and suggests the following guiding rules for Northern Nigeria.

Wherever possible forest reserves, in which fire exclusion is practised, should be situated in uninhabited areas where *G. morsitans* does not occur. In the vicinity of towns it is advisable that all streams within forest reserves should be cleared and that no attempts be made to exclude fire. In this manner areas of woodland can be safely protected from exploitation without unnatural densification and the consequent risk of becoming tsetse sanctuaries. In the vicinity of towns all fuel plantations should be situated in areas lying between streams; if possible, the edge of the plantation should not approach within a quarter of a mile of a stream.

Up to the present his investigations have led him to assume that densification of vegetation could only succeed as an anti-tsetse measure in the southern parts of Nigeria where, with a cooler moister climate, the tsetse prefer more open conditions, and the high rainfall tends to produce excessively dense vegetation.

This article cannot be more suitably concluded than by summarizing the aims and effects of tsetse control and its vital relation to vegetation in three pictures portrayed by Swynnerton in his excellent work on this subject.

He first depicts the primitive conditions of the 'scattered agriculturist and his ally the tsetse' where man lives in scattered villages, cultivates for his needs only, does not keep cattle, is raided by game, but in return hunts considerably. His surroundings consist of more or less open savanna woodland with handsome trees by the rivers—a typical tsetse habitat—which is inhabited by many kinds of game, birds, and insects. This type of country is produced by the regular grass-burning habits of man, whereby evergreen forest and deciduous thicket are destroyed and prevented from re-forming. The savanna species of tsetse owe their distribution largely to man.

This picture then changes with the introduction of domestic stock and its increasing importance as an indication of wealth. By burning, man has provided himself with enormous grazing areas, but in so doing he has unintentionally forged a dangerous weapon against himself—the increase and maintenance of the tsetse fly. 'The tsetses are the most potent preservers of the natural flora and fauna. Drive out the tsetse and the whole landscape changes.' Man with his herds retreats before the advancing fly and concentrates in the close settlements of the pastoral agriculturist. The ground is denuded of every type of tree, shrub, and even grass. The composition of the fauna is radically changed, reduced, and replaced by a few adaptable species, and various crop pests appear. The cattle become progressively poorer in condition and in time destroy their own grazing and die of starvation and disease. Bared to the winds and rain, the ground becomes eroded and the soil impoverished. Man's habits and occupations have changed, and although he has become more accessible to administration and is materially and mentally richer, he is gradually destroying the country he occupies.

Commerce, native development, and sleeping-sickness control require that the first picture, although pleasant in a fashion, should be destroyed, but surely not for the perpetuation of the second which has arisen through the lack of economic planning and the misuse of the land!

'Our third picture—that of the future—should be one of pleasant cottages with fruit trees, shady groves of the native trees preserved tsetse-less and other trees planted, rotation of crops in well-manured fields, a regulated number of cattle to the square mile, grass close-grazed and improved but not destroyed, and, in places, large nature sanctuaries, judiciously chosen and 'managed' (in the technical sense) for the perpetuation of the old flora and fauna and used not merely for this but for the delectation of the people, white and black.'

REFERENCES

SWYNNERTON, C. F. M. The tsetse flies of East Africa. A first study of their ecology with a view to their control. Published by the Royal Entomological Society, London, 1936.

NASH, T. A. M. The probable effect of densification of woodland upon the tsetse in Northern Nigeria. *W. Afr. Med. J.*, 10, No. 1 (10–13). Lagos, 1938.
—— The efficacy of bush clearing as a method of tsetse control. *W. Afr. Med. J.*, 7, No. 4, April, 1934.
—— Advice on tsetse surveys and clearings. Govt. Printer, Lagos, 1934.
LESTER, H. M. O. The progress of sleeping sickness work in Northern Nigeria. *W. Afr. Med. J.*, 10, No. 1. Lagos, 1938.
HOPE-GILL, C. W. The problem of *Trypanasoma gambiense* sleeping sickness in Southern Nigeria. *W. Afr. Med. J.*, 8, No. 3. Jan. 1935.
SYMES, C. B., and SOUTHBY, R. The reduction of *G. palpalis* in a lake shore area by the 'block method'. Govt. Printer, Kenya, 1938.
HEGH, AUSTIN and EMILE. Tsetse flies—their characteristics, distribution, and bionomics with some account of possible methods for their control. Imp. Bureau of Entomology, 1922.
Report on the eradication of tsetse fly of the *G. palpalis* group from the Pong-Tamale area, Northern Territories, Gold Coast. Govt. Printer, Accra, 1937.
Report of the Vetinerary Laboratory, Dept. Animal Health, Gold Coast. 1936–1937. Govt. Printer, Accra, 1937.

THE SWISS LEAF-CAST DISEASE OF DOUGLAS FIR

IN 1930 Gäumann reported the outbreak in Switzerland of a new and extremely serious leaf-cast of Douglas Fir, describing as the probable agent a fungus that he assigned provisionally to the genus *Adelopus* [4]. Owing to the severity of its attacks in Switzerland, and later in Germany, the disease has aroused much concern on the Continent. The present review is based on papers which have been well summarized in German by Thomas [4] and on manuscripts in the Pathology Department of the Imperial Forestry Institute.

First discovered by von Greyerz at Hardern, near Lyss, Canton of Berne, in 1925, the disease spread epidemically after a few years over the whole of Switzerland, so that to-day there are hardly any healthy stands of Douglas Fir left in that country [4]. In 1931 the disease appeared in Germany near Lake Constance [3], and shortly afterwards it was observed by Steiner in Austria [4]. A reputed outbreak in northern Germany in 1930 has been discredited by Rohde's investigations: so far the disease is restricted to the southern half of Germany, the most northerly points of its present range being Freiburg-im-Breisgau, Stuttgart, and Passau [1, 3, 4].

In the British Isles the earliest notice of the fungus—without any suggestion of disease—dates from 1928, when Wilson and Waldie recorded '*Adelopus balsamicola*' on 'dead leaves' of *Abies pectinata* at Murthly and on 'leaves' of *Pseudotsuga douglasii* in Devon (May 1927) and Antrim (June 1928) [1]. The specimens were later seen by Rohde, who claims that two different fungi are represented, that on the Douglas Fir being almost certainly identical with the fungus of the Swiss leaf-cast [1]. Day and Peace have since recorded further occurrences of the Douglas Fir fungus in Devon, Somerset, and north Wales, and cases at Bowmont Forest, Roxburgh, have been studied by Dr. Malcolm Wilson, Liese, and von Gaisberg. Specimens have also been received from County Wicklow. In these localities damage to the trees is slight compared with that reported on the Continent.

Continental authors have been puzzled by the lack of any record of the fungus in America and at a loss to explain its sudden appearance in Europe. Recently, however, Liese [5] stated that he had received a letter from Dr. Malcolm Wilson with the information that he had found the fungus in British Columbia, Oregon, and Washington, occurring abundantly on the coastal (green) type of Douglas Fir and causing slight or no damage. Dr. T. W. Childs also collected it in the same general area. These records are substantiated and amplified by a manuscript report by Dr. J. S. Boyce of Yale University, who says that Rohde has confirmed the presence of the fungus on specimens collected in 1938 from a plantation of Douglas Fir in Connecticut. A further case of infection is reported from New Hampshire, and others will doubtless be found elsewhere in the eastern States. Boyce adds a note that the fungus seems to be widespread and of long standing in the native habitat of Douglas Fir along the Pacific Slope. Wilson drew his attention to the existence of old herbarium specimens with infected leaves, and an examination of his personal herbarium brought to light infected specimens collected in Oregon and California between 1916 and 1923.

The most detailed examination of the disease has been made by Rohde, who cultured the fungus and made numerous field observations. Inoculations to prove the pathogenicity of the fungus offer difficulties and have not yet been undertaken, but Rohde's researches leave him with little doubt that it is the major, if not the sole cause of the disease [1, 3]. Other fungi, notably *Rhizosphaera*, frequently occur in infected leaves and have been suspected as alternative fruiting forms of *Adelopus*;

Rohde's cultures disprove this suspicion, but he considers that *Rhizosphaera* and other fungi may hasten leaf-fall [1].

Gäumann could not decide whether the *Adelopus* of Swiss leaf-cast was conspecific with the only known member of the genus, *A. balsamicola* (*A. nudus*), which had been recorded only as a saprophyte on dead leaves of *Abies*. After a detailed comparative study, however, Rohde concluded that the two fungi were quite distinct and described that of Swiss leaf-cast as a new species, *A. gaeumanni* Rohde [1]. Petrak agrees in separating the fungi as distinct species, but claims that the valid names for the two species should be *Phaeocryptopus nudus* (Peck). Pet. and *P. gaeumanni* (Rohde) Pet. [4].

According to Rohde [1, 3] the life-history of *P. gaeumanni* is as follows: Spores are ripened and shed in May to June, just as Douglas Fir comes into leaf. The flushing leaves are infected, and possibly older ones also. A slow-growing mycelium develops during summer and autumn, though no outward sign of disease is visible until winter, when the waxy exudations of the stomata are thrust off by the black rudiments of perithecia. In late winter and spring isolated perithecia are formed in the stomata. Mature perithecia are black and spheroidal, flattened at the base and closely appressed to the leaf surface, 0·04–0·1 mm. in diameter, with brittle walls and a conical black stipelet that occupies the outer funnel between the guard cells. Each perithecium contains about 15 closely packed asci, and each ascus 8 two-celled spores: paraphyses are lacking. Asci are formed in early May and spores begin to fall about a fortnight later. After the shedding of the first crop of spores most of the leaves usually remain on the tree and produce further perithecia in the second and third years of infection, before they are finally cast. Since empty perithecia remain attached, leaves in advanced stages have two sooty stripes on the under surface, consisting of perithecia of all ages. The presence of black perithecia is the most certain diagnostic character of the disease.

Leaf-cast is highly irregular, sometimes occurring in the autumn after infection, sometimes in the following spring, but usually not until 2 or 3 years have elapsed; thus the shedding of one year's leaves may extend over several seasons [1]. Such differences are often constant on individual trees, and Rohde distinguishes various 'reaction types' of Douglas Fir [2, 3]. Discoloration of the leaves is also a very variable feature. Loss of wax during the emergence of the perithecia at first gives the leaves a greener appearance. Discoloration proper begins after the first sporing of the fungus, when the leaves assume yellowish tones but remain predominantly green until they turn brown in dying off [4]. The loss of leaves induces a progressive reduction of growth in all parts of the tree, and if the reduction is too great the tree dies or is killed off by *Armillaria* [2]. Opening of the canopy is often followed by the development of epicormic shoots from dormant buds within the crown, a feature useful in estimating the length of attack [1]. In severe cases of defoliation sun scorch may kill the upper branches and give entrance to other fungi [2].

Rohde's 'reaction types' suggest that individual trees may show constant differences in behaviour towards the disease, but all Douglas Firs seem at present to be susceptible to infection, irrespective of race, age, or site [2, 3, 4, 5]. Since direct control is considered as far too lengthy and expensive, if not impossible [3], much concern is felt on the Continent for the future of the tree. So far, it seems that *viridis* ['coastal green'] types of Douglas Fir are the least endangered, owing to their more vigorous growth and greater needle production. Questions of races and varieties of Douglas Fir are, however, extremely confusing, and it is probable that the search for resistant types will be concerned with individual trees rather than with races or varieties as a whole. Though efforts to find resistan trees in Switzerland have failed [4], it is still possible that such trees may be discovered somewhere within the vast range of Douglas Fir as a native or introduced tree [3].

There remains the curious problem of the differences in the severity of attack on the Continent and elsewhere. Damage from the fungus seems to be almost negligible in the native habitat of Douglas Fir in western America. In the plantations of the eastern States more damage occurs, and the New Hampshire plantation referred to by Boyce contained some trees that were dying or dead. Various amounts of damage have been reported in the British Isles: in some cases injury is very slight, in others rather severe, though apparently never so severe as in Switzerland and south Germany. A number of severely damaged trees, both in England and America, are known to have suffered also from attacks by the fungus *Rhabdocline pseudotsugae* and the insect *Adelges* [*Chermes*] *cooleyi*, and it is difficult in such cases to assess the true extent of damage by *Phaeocryptopus*. The general conclusion, however, is that the disease is most acute in central Europe, where, unless reports are much exaggerated, it has very serious effects. The geographical distribution of damage seems to

point to the balance between tree and climate as the limiting factor for the pathogenicity of the fungus, as Rohde [3] and Boyce have tentatively suggested. It is also conceivable that a new pathogenic strain of the fungus infecting Douglas Fir in its native habitat may have arisen [Boyce]; but until more information is available on the position in America, the British Isles, and possibly in other localities as yet unreported, any conclusion on this point would be premature.

REFERENCES

[1] ROHDE, T. Über die 'Schweizer' Douglasienschütte und ihren vermuteten Erreger *Adelopus* spec. [On the 'Swiss' leaf-cast of Douglas Fir and its supposed excitant *Adelopus* sp.] *Mitt. Forstwirt.* 8, No. 4. 1937 [487–514].

[2] —— Die Wirkung der Schweizer Douglasienschütte in ihrem Ursprungsgebiet. [Effects of the Swiss leaf-cast in its region of origin.] *Deutsche Forstbeamtenztg.* 7, No. 1. 1938 [6–13].

[3] —— Können wir den weiteren Anbau der Douglasie noch verantworten? [Can we still recommend the further cultivation of Douglas Fir?] *Deutsche Forstwirt.* 20, No. 7. 1938 [81–5].

[4] THOMAS, E. A. Über die Schweizer Douglasienschütte. [On the Swiss leaf-cast of Douglas Fir.] *Schweiz. Zeitschr. Forstw.* 90, No. 2. 1939 [55–62].

[5] LIESE, J. Zur Frage des weiteren Anbaues der Douglasie in Deutschland unter Berücksichtigung der *Adelopus*-Nadelschütte. [On the question of the further cultivation of Douglas Fir in Germany, with reference to the *Adelopus* leaf-cast.] *Mitt. d. Dendr. Ges.* 51. 1938 [212–18].

Further references may be found in the bibliographies of [1], [2], and [4].

ABSTRACT SECTION

NOTE.—A capital letter in square brackets following the reference denotes the language in which the paper is written. A small letter denotes a summary in another or the same language, e.g. [G.e.]—German, with English summary. English [E.] is only indicated for papers published in journals usually written in foreign languages. The letters F.P.R.L. stand for Forest Products Research Laboratories (Princes Risborough) from which the particular literature has been obtained. Conf. ppr. is the abbreviation for Conference paper.

0. GENERAL FORESTRY

05. PERIODICALS

05.3 : 86. SMYTHIES, E. A. **Forest administration reports.** *Ind. For.* 65, 1939 (135–6).

A plea for concentration upon important matters of policy and developments, to the exclusion of minor details of little general interest.

07. EDUCATION. RESEARCH. TRAVEL AND STUDY

07. CHALK, L. **A forestry tour in 1937.** *Institute Paper* No. 16. Imperial Forestry Institute, Univ. of Oxford. 1939. pp. 71.

The objects of this tour were (*a*) to study the problem of higher education, (*b*) to explore the possibilities of co-operation between forest research organizations, and (*c*) to obtain, in so far as time permitted, a general impression of the conditions in which forestry is practised in the territories included in the tour. The following countries were visited: U.S.A., Canada, British Honduras, Hawaii, Fiji, New Zealand, Australia, Java, Malaya, Burma, India, and Ceylon.

The training given at the certain schools is described and the views of serving foresters discussed. The chief criticisms made are overcrowding of the syllabus and lack of sufficient grounding in science, and the remedy suggested is to treat forestry as a subject for graduate study following a science degree rather than to increase the length of the existing undergraduate course.

The respective roles of empirical experiment and fundamental research are discussed in relation to the organization of research; for fundamental research larger units are desirable, but these tend to overlap; and closer co-operation is urged both in different countries and in different fields. The need for special training for research officers is stressed.

Means of increasing co-operation between wood anatomists are suggested, particularly with a view to facilitating research on the identification of timbers. Attention is drawn to the importance of wood anatomy as a link between silviculture and utilization, for which physiological research is essential. This field of research is often hampered by the artificial distinction commonly drawn between research on the living tree and on the dead timber.

07.1 : 97 (73). **Report of Committee on Farm Forestry Education in the Agricultural Colleges.** Presented at the annual meeting of the Society of American Foresters. *Jnl. For.* 37, 1939 (123–9). Conf. ppr.

07.2 (47.1). HEIKINHEIMO, O. **The Forest Research Institute of Finland and its activities from 1918 to 1938.** *Repr.* from *Comm. Inst. For. Fenn.* 28, 1939 (1–39). [E.]

The history, organization, and functions of the Institute are outlined. Established in July 1918 under a Senate Ordinance of Oct. 1917, the Institute was originally subordinate to the State Forest Service and later under the Minister of Agriculture. However, in 1937 it was made independent of Government Departments and placed under the control of a Directorate made up of the Professors of the Institute and a Chief Forest Officer.

The Institute is subdivided into seven sections consisting of six Research Sections, each under a professor, dealing respectively with Silviculture, Forest Mensuration and Forest Management, Soil Science, Swamp Science, Forest Economics, and Forest Technology, and one section, under the Chief Forest Officer, dealing with the management of experimental forests.

The function of the Institute is to study the forestry of Finland preparatory to the proper

development of national forestry, and also to take part in international forest research. To facilitate domestic investigations a number of experimental forests have been established and are administered by the Institute for long-range research and the study of sustained yield. These forests are listed in the report together with the date of their establishment and total area, and an attached map indicates their relative size and position in the country. Research stations are attached to most of these reserves. A number of Nature Reserves have also been established and are in the charge of the Institute. These are listed and located in the report.

The growth of the research activities of the Institute is shown by the growth of expenditures from £992 in 1920 to £14,217 in 1937. The Forest Experiment Section has shown a surplus of revenue over expenditure for the years 1931 to 1938 inclusive. In 1938 the revenue amounted to £31,111, while expenditure was £14,667.

The work of each section of the Institute, from the time of its inception until 1938, is dealt with in some detail. Technical publications concerned with this work are issued as a scientific series entitled *Communicationes Instituti Forestalis Fenniae* and are written in Finnish, German, or English. A considerable quantity of popular literature, for educational and publicity purposes, is issued by the Institute. A list of all literature that has so far been issued, together with dates of publication, is appended to the report.

07.2 (91). MALAYA. **Forest Research Institute, Kepong: programme of research for 1939.** Forest Department, Federated Malay States and Straits Settlements. 1939. pp. 14.

An outline of all proposed field, laboratory, and office work for each technical division of the Forest Research Institute. Included is a list of all standard service tests of timber that were under observation at the beginning of 1939.

09. FOREST HISTORY. FOREST GEOGRAPHY. MONOGRAPHS ON INDIVIDUAL COUNTRIES AND FOREST REGIONS

09.2 (74.7). MCCULLOCH, W. F. **A post-glacial forest in central New York.** *Ecology* 20, 1939 (264–71).

The identification and counting of forest tree pollen grains obtained at levels from 1 to 18 ft. deep in a peat bog are used as a means of determining the development of the post-glacial forest in this region.

09.7 (71.3). ZAVITZ, E. J. **The development of forestry in Ontario.** *For. Chron.* 15, 1939 (36–43). Conf. ppr.

09.7 : 09.4 (73). GARVER, R. D. **The nation's timber stand.** *Am. Forests* 45, 1939 (66–8).

A review of the U.S. Stock Survey.

09.7 : 09.4 (73). GARVER, R. D. **The national timber stand.** *Jnl. For.* 37, 1939 (92–8).

A brief review of the results of the U.S. Forest Survey.

09.7 : 09.4 (76.4). CRUIKSHANK, J. W., ELDREDGE, I. F., and WHEELER, P. R. **Forest resources of South-eastern Texas.** U.S.D.A. *Misc. Publ.* No. 326. Supt. of Documents, Washington, D.C. 1939. pp. 36.

09.7 : 2 : 3 (498). **Forest exploitation in Roumania.** *Rev. int. du bois* 6, 1939 (143–56). [F.f.]

Notes are included on the size, value, utilization, and revenue of State forests; on the silvicultural operations undertaken in recent years, including costs; and on Government-owned sawmills and forest railways. The considerable progress made in recent years by the State Forest Service is ascribed to its organization on a commercial basis.

09.7 : 23.3 (61.2). FUNICIELLO, L. **The forestry problem in Tripoli.** *Riv. For. Ital.* 1, 1939 (27–36). [It.]

With special reference to afforestation.

09.7 : 3 (87). MONSANTO, L. E. **Venezuelan forests.** *Rev. int. du bois* 6, 1939 (140–2). [F.]

A short note on the utilization of various woods.

09.7 : 33.38 (61.1). BOCHET, J. **Forests of the high plateaux of Tunis.** *Rev. int. prod. col.* 14, 1939 (24–34). [F.]

These forests cover roughly 750,000 hectares, or about three-quarters of the total forest area of Tunis. They are at present little utilized and their future depends mainly on the creation of a market for wood and charcoal for producer-gas. Natural, economic, and strategic conditions are very favourable for large-scale development of the use of producer-gas in Tunis: all that is needed for the firm establishment of this source of power is well-planned organization and propaganda.

09.7 : 43.1 : 2 : 6 (69). LOUVEL. **The protection, management, and study of the forests of Madagascar.** *Actes et Comptes Rendus de l'Association Colonies-Sciences* 15, 1939 (16–21). [F.]

Of the total area of Madagascar, estimated at 59 million hectares, only about 10 per cent. is covered with forest. Fire is a particularly serious cause of deforestation. Counter fires and the planting of fire lanes of such species as Aloes and Agaves are considered the only effective means of fire protection. Although shifting cultivation of rice is diminishing, it still accounts for considerable forest damage, while exploitation by private firms impoverishes the stock of valuable species. In recent years the Forest Service has increased considerably, and since 1927 reserves of 350,000 hectares have been constituted. An attempt is being made to reduce the proportion of species of low value by cutting them for firewood and charcoal manufacture wherever possible. The colony has at present three forest research stations engaged mainly on silvicultural work and the study of the species used in the afforestation of the coastal zone.

1. FUNDAMENTAL NATURAL LAWS OF THE FOREST

11. LOCALITY. STUDY OF LOCALITY. MAINTENANCE OF LOCALITY FACTORS

11. KRAUSS, G. **On the description of forest sites.** *Forstarchiv* 15, 1939 (85–93). [G.]

The article contains suggestions for revision of the 'Instructions for the description of sites and stands for purposes of forest research based on the resolution of 3rd September 1938 of the Union of German Forest Research Institutions'. The collection of data under the headings 'situation', 'climate', and 'soil' is discussed, and it is pointed out that it would be very advantageous if a classification of forest sites could be devised that would express the real and permanent productivity of a given site as such, and not merely the quality of the stand found on it at the time of survey.

11.1. *Atmosphere*

11.12.4. WOELFLE, M. **Wind conditions in the forest.** *Forstw. Centralbl.* 61, 1939 (65–75.) [G.]

The wind velocity at 50 cm. above soil level in the immediate neighbourhood (1 m., 2 m., and 3 m. from the bark) of a not quite isolated standard was slightly decreased to windward and in the lee but considerably increased at right angles to the wind. The increase was most pronounced (over 30 per cent.) at 1 m. from the bark somewhat to leeward.

11.14 : 07.7. DAVIS, W. E. **Measurement of precipitation above forest canopies.** *Jnl. For.* 37, 1939 (324–9).

The design and operation of a hoist that will raise a standard rain gauge to the tree crown surface and permit random sampling of precipitation at this level without the erection of towers or platforms, or the pruning of surrounding vegetation.

11.14 : 42.32(77.3). CROXTON, W. C. **A study of the tolerance of trees to breakage by ice accumulation.** *Ecology* 20, 1939 (71–3).

Damage to park and street trees after a sleet storm in Illinois. Nine hundred and seventy-nine trees of 52 different species were classified according to the extent of injury. Differences in the behaviour of the various species were marked, but no detailed analysis was made of the factors involved.

11.15.11. BROCKS, K. **The spatial distribution of light intensity in the forest.** *Zeitschr. F. & J.* 71, 1939 (47–53). [G.]

A selenium cell as devised by Lange was used to measure solar light intensity in regard to varying inclinations of light, diurnal variations, the effect of clouds, and the effect of foliage. Each series of measurements was arranged in such a manner as to furnish comparative data on the light intensity of 37 theoretical surfaces of a hemisphere at 1 m. above soil level. Under a close canopy light intensity was highest near the zenith and very uniform for all directions. Diurnal and local variations were small and in the middle of the day the light intensity of the lightest surface fell to below 1 per cent. of that in the open.

11.15.11 : 07.7. BACON, E. M. **The use of photo-electric cells for sampling light in forest stands.** *Jnl. For.* 37, 1939 (55–60).

To eliminate errors due to variations in the angle of inclination, which are liable to arise when a flat sensitive surface is used, the photo-

electric cell is enclosed in an integrating sphere. The results secured by the use of the new device, both for hand sampling and continuous recording, are presented and discussed.

11.15.2 : 12.11.2 : 23.26 : (12.25.53) MITCHELL, H. L., and ROSENDAHL, R. O. **The relationships between cumulative solar radiation and the dry weight increase of nursery-grown White Pine and Red Pine seedlings.** *Black Rock Forest Papers* 1 (13). 1939. pp. 6.

An arithmetic-logarithmic correlation in the form of a linear proportion was found between seedling yields expressed as dry weight and cumulative solar radiation under certain conditions of mineral nutrition. The stimulating effect of solar radiation was relatively greater for root than for shoot development; thus seedlings exposed to full sunlight during the greater part of the growing season were not only heavier but had better root systems and a more favourable root/shoot ratio than plants grown in lower light intensities. There was some evidence that yields and root/shoot ratios of seedlings grown in different years in the same localities were influenced indirectly by climatic factors which, by altering the ratio of infra-red to visible radiation, effected a change in the quality of solar radiation.

11.15.2 : 12.19 : 12.15 (44.78). CHOUARD, P. Le rayonnement solaire et ses rapports avec la végétation dans le Massif Pyrénéen de Néouvieille. [**Solar radiation and its relation to the vegetation of the Néouvieille Massif in the Pyrenees.**] Travaux de Laboratoire Forestier de Toulouse, Tôme VI, Vol. II, Article II. 1939. pp. 13.

Extremely high solar radiation explains to a large extent the unusual elevations at which Pine forests are found. *Pinus silvestris* is found at 2,200 m. and *Pinus uncinata* at 2,500 m. above sea-level.

11.16.4 : 42.33 (494). ENGEL, A. **The effects of hail in the forest.** *Bull. S. Fr.-Comté* 23, 1939 (12–20). [F.]

A description of severe hail damage at Ripaille, Switzerland, on the 1st July 1935, and of the development during the following three years of the affected crops (old Oak, Oak regeneration, and plantations of conifers, Oak, White Poplar, Robinia, Ash, and Maple). With the exception of Oak, the wounds of which healed very slowly, all crops were more or less recovered by September 1938, although some trees of each species had suffered so severely from the hail and from subsequent insect attack that their removal in future cleanings and thinnings was imperative.

11.2. *Climate*

11.22 : 11.63 (77.2). POTZGER, J. E. **Microclimate and a notable case of its influence on a ridge in Central Indiana.** *Ecology* 20, 1939 (29–37).

Ridges in Munroe County, Indiana, have characteristically Beech-Maple forests on north slopes and Oak-Hickory on south slopes. One of these ridges was studied for a period of 20 weeks as to evaporation and soil-moisture differences on the two slopes. Evaporation was found to be consistently higher on the south slope which, for the season of 1934, had 61 per cent. more evaporation loss than the north slope. Surface soil had 30 per cent. and soil at 6 in. depth 28 per cent. more moisture on the north than on the south slope. Differences in wind, insolation, temperature, and humus content of the soil are suggested as causes for differences in available soil moisture. *From author's summary.*

11.4. *Soil*

11.4 : 07.2 (77). AUTEN, J. T. **A forest soil research programme for the Central States.** *Jnl. For.* 37, 1939 (153–6). Conf. ppr.

11.41. Soil physics

11.41.33 : 24.41 : 23.3 (76). STOECKELER, J. H., and BATES, C. G. **Shelterbelts: the advantages of porous soils for trees.** *Jnl. For.* 37, 1939 (205–21).

Records from Oklahoma and elsewhere show the moisture supply available for trees planted in the Plains region to be greater in sandy soils than in those of finer texture. In periods of abundant rain the latter release water more slowly from the surface to the deeper layers and less water is stored. A dried-out silty or clay soil requires a much larger amount of moisture for replenishment even to the wilting coefficient. The formation of plantations should be preceded by the building up of a moisture reserve of not less than about 4 in. of free water in the upper 4 ft. of the soil. A table is given to facilitate the determination of free moisture without elaborate sampling devices. Methods of main-

taining moisture throughout the life of the plantations, e.g. by fairly wide spacing and inter-tillage or, as an alternative, dense planting to shade the ground and safeguard the accumulation of litter, are discussed. It is also suggested that pits, terraces, or other devices for concentrating most of the rainfall on part of the area may permit the permanent subsistence of trees on fine-textured soils with little or no cultivation. The practical application of the method would depend entirely on the use of special machinery to minimize initial cost.

11.41.62.4 : 42.21: 23.26.7. Jones, F. H., and Peace, T. R. **Experiments with frost heaving.** *Quar. Jnl. For.* 33, 1939 (79–89).

As the soil freezes ice layers are formed in it, and with the consequent volume expansion the soil is forced upward. This action is intensified by the withdrawal of water from the lower levels by capillary action. Measurements of frost lift were recorded for a heavy, cultivated soil with the following results:

	1936–7	1937–8
Average lift . .	5·5 mm.	7·0 mm.
Highest lift . .	18·5 mm.	27·0 mm.

It was determined that the degree of lift was affected by the amount of water available as well as by the degree of frost. A series of experiments was undertaken to determine the relation between frost action and (*a*) type of soil, (*b*) substance used as a protective covering of the soil, (*c*) density and methods of sowing, and (*d*) rate of thawing. Of the six soils tested a sandy loam gave the least reaction of an average lift of 1·0 mm., while a heavy alluvial soil with some clay gave the highest reaction of an average lift of 16·0 mm. It is probable that the value of various protective substances varies with the type of soil. It appears that frost lift varies inversely with density of sowing and that early sowing is advisable. Sudden thawing of nursery beds should be avoided where possible.

11.43. Biology of soil

11.43.1 (79.2). Henry, Le R. K. **Mycorrhizae from the Uinta Basin [Utah].** *Ann. Carnegie Mus.* 25, 1936 (63–70).

Ectotrophic mycorrhizae occurred on 8 of the 15 species examined. The majority of the hosts grew on neutral or slightly acid soil and none where soil conditions were those of typical alkaline desert. All but one of the non-mycorrhizal plants grew under distinctly alkaline conditions. This seems to indicate that the mycorrhizae were able to grow and flourish in sand or sand-humus mixtures under neutral or slightly acid conditions only. Mycorrhizal host plants were: *Abies lasiocarpa*, *Betula fontinalis*, *Picea engelmannii*, *Pinus brachyptera*, *P. edulis*, *P. murrayana*, and *Populus aurea*. No mycorrhizae were found in *Acer interius*, *Amelanchier utahensis*, *Artemisia tridentata*, *Juniperus utahensis*, *J. sibirica*, *Rhus trilobata*, and *Sarcobatus vermiculatus*. [Condensed from A. P. Kelley, *Additions to the literature of mycorrhizae, 1938.*]

11.43.1 : 12.26.41. Kelley, A. P. **The form and occurrence of mycorrhizae in the genus Populus.** *Landenberg Review* 1937 (54–6).

Roots of *P. tremuloides* from Iowa, Minnesota, and Pennsylvania were found in all cases to be mycorrhizal. [Condensed from A. P. Kelley, *Additions to the literature of mycorrhizae, 1938.*]

11.44. Soil cover

11.44.2 : 11.43 : 11.42. Wittich, W. **Research on the process of litter decomposition on a soil with mull conditions.** *Forstarchiv* 15, 1939 (96–111). [G.g.]

A study of the decomposition of tree litter under the combined action of micro-organisms and of the soil fauna. The broad-leaved species examined were Ash, Acacia, Hagberry, Sweet Chestnut, Hornbeam, Oak, Birch, and Beech, and the rate at which litter decomposition took place follows this order, that of Ash being the fastest. The decomposition of coniferous litter depended almost entirely on the soil fauna. Larch litter, which apparently possessed little attraction for them, showed the slowest rate of decomposition. No definite relationships could be established between lignin content and rate of decomposition, and some litter rich in lignin, as that of Acacia, decomposed very rapidly. It is suggested that the rate of decomposition depends essentially on the tendency of the litter to break up into small particles, thus increasing the contact surface and the tendency to mix with the soil. This process depends in turn on the structure of the leaf and the readiness with which micro-organisms attack the parts of its tissue which do not contain lignin. The C/N ratio appears to be of importance in this connexion.

11.45. Geological and Geognostical conditions

11.45.9 (945). Penman, F., Taylor, J. K., Hooper, P. D., and Marshall, T. J. **A soil survey of the Merbein Irrigation District, Victoria.** *Austral. C.S.I.R. Bull.* No. 123. Govt. Printer, Melbourne, Australia. 1939. pp. 44.

11.47. Maintenance of favourable soil conditions

11.47 : 23.26.4. Wilde, S. A., and Wittenkamp, R. **The phosphate and potash starvation of forest seedlings as a result of the shallow application of organic matter.** *Jnl. For.* 37, 1939 (333–5).

A series of experiments show that the application of top dressings to nursery soil tend to arrest the downward extension of the seedling root systems and thus deprive them of important nutrients, mainly phosphate and potash, which are present in the soil at a greater depth. Alternate ploughing and disking, or roto-tilling are recommended to prevent this condition.

11.47.1 : 22.56. Němec, A. **Experiment on fertilizing forest soils in agricultural intercultivation in the Malacky forestry region.** *Sborn. Čsl. Akad. Zeměd.* 13, 1938 (638–49). [Cz.g.]

Forest on sandy soils in this semi-arid region is cut down, the soil mechanically loosened and sown with rye, millet, or potatoes and cultivated for 2–4 years before planting Pine. The soils respond well to phosphate and potash. [*Soils and Fertilizers* 2, 1939: 140–1.]

11.47.12.4 : 11.47.13 : 23.26. Němec, A. **The influence of manuring with compost upon the growth of Spruce in nurseries.** *Lesnická Práce* 18, 1939 (148–56). [Cz.g.]

Compost manuring of 3-year-old Spruce transplants at the rate of 30 kg. for each 100 sq. m. had a beneficial effect with soils of average calcium content and those rich in calcium but very poor in nitrogen. For soils having a marked lime deficiency the treatment was found ineffective and even harmful unless artificial fertilizers were employed at the same time. Comparative studies of the results obtained from manuring with compost and with artificial fertilizers, proved the superiority of the latter, provided they were correctly and carefully applied. Otherwise it is much safer to employ compost.

11.47.13.3 : 12.25.5. Fabricius, L. **Experiment I on the liming of forest soils.** *Forstw. Centralbl.* 61, 1939 (129–37). [G.]

A definite response of young Spruce and Pine was observed in the course of 6 years immediately following the treatment of soil with lime.

11.47.13.3 : 12.25.5 (43). Fabricius, L. **Experiment II on the liming of forest soils.** *Forstw. Centralbl.* 61, 1939 (229–37). [G.]

In experiments undertaken at Wendelstein near Nuremberg, 1929–37, the treatment of extremely lime-deficient soils with varying applications (2,000–5,000 kg./ha.) of quicklime and chalk did not produce any response in Pine seedlings during the 8 years following liming and sowing. On the other hand, applications of 2,000 kg./ha. of either quicklime or chalk were sufficient to obtain satisfactory growth in Spruce and Larch and to assure their survival in mixture with Pine. In none of the plots did quicklime prove greatly superior to chalk.

11.47.19 : 12.11.1 : 23.26 : 12.25.53. Mitchell, H. L. **The growth and nutrition of White Pine [*Pinus strobus* L.] seedlings in cultures with varying nitrogen, phosphorus, potassium, and calcium:** with observations on the relation of seed weight to seedling yield. *Black Rock Forest Bull.* No. 9. 1939. pp. 135.

Culture experiments to determine the nutrition requirements of White Pine seedlings. Curves were calculated by the Mitscherlich equation to show the relationship between seedling yields by dry weight and each of the four nutrient elements, which were varied individually in a series of cultures to which all other essential elements were supplied in constant and approximately optimum amounts. For each of the elements there appeared to be an optimum internal nutrient concentration range (seedling content of N, P, K, and Ca expressed either as milligrams or per cent. of dry weights) which was proportional to the external supply, and which showed a good correlation with yield. These relationships appeared to be equally true of nursery-grown seedlings. Thus fertilizer applications based on the results of periodic chemical analyses of the seedlings were apparently more effective than nutrient supplements made without regard to internal nutrient concentration.

11.47.21 (213). FREISE, F. W. **Investigations on the effects of burning debris in tropical soils.** Observations in coastal virgin forests of Brazil. *Tropenpflanzer* 42, 1939 (1–22). [G.g.]

The clear-cutting of virgin forest followed by repeated burning of debris and ground vegetation, before and in the course of agricultural cultivation, will seriously reduce the permeability of the soil, and will result eventually in almost complete destruction of the micro-flora and fauna. The presence of mineral nutrients is more pronounced in areas adjoining burnt plots than within them. It appears that erosion on denuded and burnt areas is due largely to the 'shattering' effect of salts breaking up the soil particles. From the author's small-scale experiments it appears that the effects of repeated burning can be reduced to a considerable extent by loosening the burnt-over soil and spraying it with water. Nevertheless, natural regeneration will be possible only after a gradual removal of the scurf by wind and rain.

11.47.6 : 11.42.1 : 23.26 : 12.25.5. WILDE, S. A. **Soil-fertility standards for growing northern conifers in forest nurseries.** *Repr.* from *Jnl. Agric. Res.* 57, 1938 (945–52).

Based on the knowledge that productive forest soils will produce at least one crop of vigorous seedlings of the species that originally grew on the area, detailed study was made of the soils under productive stands of *Pinus banksiana*, *P. resinosa*, *P. strobus*, *Picea glauca*, *Abies balsamea*, and also mixed northern hardwoods. Analyses were made for pH value, exchange capacity, total and available nitrogen, available phosphorus, available potash, and replaceable bases. Standards for the maintenance of fertility in coniferous nursery soils were established by statistical treatment of the data so obtained. The analyses of virgin soils showed that the nitrogen : phosphoric acid : potash ratio is about 1 : 2 : 5. It is pointed out that soil improvement does not mean merely the addition of a certain amount of organic matter and mineral fertilizers. A period of physiochemical and biological activity is necessary to incorporate the required materials into the soil complex. General directions for the adjustment of soil conditions are outlined.

11.48. Kinds of soil

11.48 (47.43). KAKTIŅŠ, E. **The forest soils of the Bauska District according to data from the land register.** *Mežsaimniecības rakstu Krājums* [Riga] 16, 1938 (98–112.) [Latv.g.]

11.6. *Hydrographical Conditions*

11.62.21. SCHAEFFER, L. **The forestry movement abroad: the water table and forest vegetation.** *Rev. E. & F.* 77, 1939 (130–41). [F.f.]

This paper is based mainly on Ijjasz's work at the Sopron Research Station, Hungary, in connexion with waste land reclamation in the plains of the Danube and the Tisza Rivers. The forests of the plains usually lower the ground-water table except in years of abundant rainfall and in the case of forest tree species of feeble transpiration, such as *Robinia*. The depth at which ground water ceases to be a factor in tree nutrition depends on local conditions and particularly on root depth. In most cases ground water becomes inactive below 6–7 m., as tree roots rarely go deeper than 4 m., while the maximum capillary rise of water is 2–3 m.

11.63. Forest and Water. Forest and Climate. Erosion

11.63 (67). **Soil erosion.** *Brit. E. Africa, Conf. of Governors*, June, 1938. pp. 11.

Memorandum by the Governments of Uganda, Kenya, and Tanganyika on control measures and results. [*Soils and Fertilizers* 2, 1939: 120.]

11.63 (73). HURSH, C. R., and CONNAUGHTON, C. A. **Effects of forests upon local climate.** *Jnl. For.* 36, 1938 (864–6).

Every wooded, cleared, or burnt area has its own local climate, which vitally influences tree growth and regeneration. Vegetation and local climate are largely interdependent. Early empirical observations suggested that the climatic factors most directly affected by the forest were temperature, humidity, amount and velocity of wind, evaporation, and precipitation. More careful studies made in America since 1928 provide ample proof that, while present evidence cannot justify the belief that forests materially influence general climate over wide areas, they have a marked influence upon local climate. In general, the larger the area of forest, the greater its influence on climate. Opportunities for examining large, strictly comparable areas differing only in the presence or absence of forest are rare. In eastern Tennessee, how-

ever, there is an area of 7,000 acres in Copper Basin completely denuded by smelter fumes. It is surrounded by a zone of 12,000 acres covered with perennial grasses, which is in turn surrounded by hardwood forest similar to that which formerly occupied the whole basin. Records over two years (1935 and 1936) show that the average daily temperature is 3 to 4° lower in the forest throughout the year. In the denuded zones the average wind velocity is 7 to 10 times as great as in the forest in winter and 34 to 40 times in summer; while evaporation is twice as great in winter and 7 times in summer. Striking differences in precipitation were recorded: winter precipitation for the two years respectively was 25 and 17·5 per cent. greater, and summer precipitation for the two years together 28 per cent. greater in the forest than in the open. The record is, however, much too short to justify any claim that forests 'produce rain'.

Forest cover has been shown to intercept and dissipate a considerable amount of snow and rainfall, to retard the melting of snow, and to encourage infiltration of water into the soil. Forests managed for production can therefore perform a further service in regulation of stream-flow. In forest studied in the 40-in. rainfall belt of the Southern Appalachians, the percentage of the total annual precipitation intercepted was 12 to 18, of which 1 to 3 per cent. later reached the ground.

In the Prairie-Plains region shelterbelts of suitable height, density, and spacing have been effective in reducing wind velocities by 10 to 50 or even 70 per cent. This reduction in turn diminishes soil blowing and evaporation but owing to a combination of causes, shelterbelts can only slightly delay—and rarely prevent—the exhaustion of soil moisture by prolonged drought. Certain trees may even drain the subsoil of its moisture from a greater depth than most field crops, and research is in progress to discover the trees that are least extravagant in their water requirements. Some trees classed as drought-resistant may survive, not because they use less water but because their root system extends farther in search of it.

Since man is able to effect radical change in the character of forests, and has done so on a vast scale, knowledge of the relationships between forests and local climate is basic to good silviculture, forest protection, and 'watershed management'.

The silviculturist can regulate regeneration, both in quantity and quality, by careful manipulation of the overwood. In some cases clear cutting had the effect of modifying local climate so as to favour regeneration of certain species at the expense of others, while in others the modification was so extreme that no regeneration took place. In one instance the presence of an overwood reduced losses of Chestnut Oak seedlings by narrowing the temperature range.

Fire hazard is often increased by removal of the forest cover, since inflammability is enhanced by the higher temperatures, greater wind movement, and greater evaporation induced. In one region surface duff in the open became inflammable about 7½ days earlier after a rain than that in the forest.

'Watershed management', however, is complicated by inadequate understanding of the parts played by interception, evaporation, transpiration, run-off, and seepage, which must yet be assessed and balanced in any plan having as its dual purpose flood control and water conservation. Maintenance by the forest of maximum infiltration capacity of the soil in order to check excessive run-off must be weighed against transpiration losses. Stream discharge from forested catchments shows a marked diurnal fluctuation in volume attributable to a greater demand on soil water by transpiring vegetation during the day than at night.

The effects of forest upon local climate are marked, but generalization is difficult. Forest appears always to reduce wind movement and evaporation, but broad pronouncements as to its effect on temperature, or on precipitation reaching the ground, require so much qualification as to be meaningless, and each set of local conditions must be studied individually. Emphasis is laid upon the paucity of present knowledge of the complex interactions of vegetation and local climate in the numerous forest types, and the need for further research is urged.

11.63 (73). **Report of the Committee on Watershed Management.**—Presented at the annual meeting of the Society of American Foresters. *Jnl. For.* 37, 1939 (137–8). Conf. ppr.

11.63.11 (97). **A review of the position in regard to soil conservation in the Colonial Empire in 1937.** Colonial Office. 1939. pp. 72.

11.63.11 (729). HARDY, F. **Soil erosion in St. Vincent, B.W.I.** *Trop. Agric.* 16, 1939 (58–65).

11.63 : 11.2 : 11.14. CARTON, P., and SALLENAVE, P. **Considerations on the reciprocal action of forests and climate.** *Bull. écon. Indochine* 41, 1938 (294–319). [F.]

Accurate records extending over a period of 27 years have enabled one of the joint authors to construct large-scale maps of mean annual and monthly rainfall in various parts of Indo-China. The maps furnish no evidence that forests influence general rainfall, though they show very clearly that the chief determining factors are monsoons and local winds, topography, distance from the sea, and the repeated action of typhoons and depressions. From this and from a discussion of the views of meteorologists it is concluded that the influence of forests upon the general climate of large areas has not yet been proved by systematic observation and is either very slight or non-existent. On theoretical grounds, however, it is conceivable that by absorbing and transpiring water, forests may delay the return of rain to the sea and increase local precipitation to a slight extent without altering the general climate. As regards local climate, large wooded tracts lower the temperature and increase the humidity of the undermost layer of the atmosphere; under certain conditions they may cause mist or fog and lower the cloud 'ceiling'; occasionally they may also provoke light breezes in the daytime. Such effects seem to be strictly local.

The real and undeniable effect of forest upon the environment is to create and maintain a more equable microclimate. Under the shelter of forest, illumination is less, humidity higher, and diurnal and annual variations of humidity and temperature lower than in adjacent open ground. Such effects vary according to the type and structure of the forest and are highly important from the ecological point of view. The following condensed tables of results obtained in Cochin-China illustrate the effects of dense forest on microclimate.

The grave consequences of deforestation in arid climates or climates with periodical aridity are due, not to change in the general climate, but to destruction of the forest microclimate. The microclimate of forests directly conditions their soil climate, and both of these are vital factors in the turnover of organic matter and the water régime of the soil. Further beneficial effects of the mere presence of forest are the prevention of erosion and the regularization of the mean flow of springs and streams. The forest may depend upon these effects and upon the maintenance of a favourable microclimate for its existence and for its ability to regenerate.

Data from the Trang-bôm Forest Experiment Station based on the mean year for the period 1933–7

	In open	*Under forest*	*Difference*
Air temperature (° C.)			
Annual mean of maxima	32.1	28.4	3·7
" " minima	21.4	22·5	1·1
Difference	10·7	5·9	4·8
Maximum diurnal range	18·5	13·5	5·0
Minimum " "	1·0	0·3	0·7
Difference between extreme max. and extreme min. for whole period	27·7	24·0	3·7
Relative humidity (%)			
Mean annual at 6 a.m.	97·9	96·7	1·2
" " 2 p.m.	67·1	82·3	15·2
Difference	30·8	14·4	16·4
Greatest difference between mean monthly at 6 a.m. and 2 p.m.	51·8	42·9	8·9
Smallest difference between mean monthly at 6 a.m. and 2 p.m.	10·7	2·7	8·0
Difference between extreme max. and extreme min. at 2 p.m. for whole of period recorded	77·0	72·0	5·0
Evaporation (in mm.)			
Total for mean year	702·2	297·5	404·7
Highest monthly total	126·4	67·1	59·3
Lowest " "	26·2	6·6	19·6
Mean total per 24 hours	1·9	0·8	1·1
Maximum per 24 hours in whole period	8·3	3·9	4·4
Minimum per 24 hours in whole period	0·2	0·0	0·2

11.63 : 33 : 34 (922.3). HERINGA, P. K. **The position of reforestation in relation to industrialization in East Java.** *Tectona* 32, 1939 (256–64). [Du.e.] Extr. from '*Het Landbouwkundig Tijdschrift, maandblad van het Ned. Genootschap voor Landbouwetenschap*' No. 611. 1938.

Forests occupy one-fifth of the total area of the island and are maintained mainly for hydrological reasons. The Government has recently stopped leasing forest land to agricultural settlers as it is thought that further deforestation would result in a lower agricultural output of the island as a whole and would particularly prejudice the irrigated rice plantations. At the same time, an attempt is being made to meet the pressure of population by developing forest industries, such as the manufacture of chests,

cases, matches, boxes, paper, chopped and ground bark of *Acacia decurrens*, and the extraction and preparation of tannin extracts, turpentine, tung and other *Aleurites* oils, *Santalum* oil, &c. With this policy in view, plots of 1,000 to 10,000 acres have been selected at different elevations within the mountain forests, each plot to provide one of the above-mentioned industries with raw material. These plantations are laid out with due regard to the maintenance of the hydrological value of the natural woods.

11.63.1. ROESSEL, B. **A hydrological study of the nature of retention in the water cycle.** *Tectona* 32, 1939 (1–82). [Du.g.]

A critical survey of the existing data on the influence of forest vegetation on water retention, including Engler's observations in Switzerland (Sperbelgraben and Rappelgraben) and the experiments of Bates and Henry at Wagon Wheel Gap in Colorado. With reference to this problem in Java, the author admits the possibility of a favourable influence of the forest vegetation on the water régime only where the soil is very impermeable.

11.63.1 (76.8). BAKER, W. M. **The place of forestry in soil and water conservation in the Tennessee Valley.** *Jnl. For.* 37, 1939 (157–60).

12.11.14. MINCKLER, L. S. **Transpiration of trees and forests.** *Jnl. For.* 37, 1939 (336–9).

As a result of experiments conducted under diverse conditions on 12 individual trees, including 5 species, the transpiration in acre-inches of a hypothetical forest was found to range from 4·72 to 17·02 for Red Maple, 1·52 to 7·37 for American Elm, and 2·35 to 7·87 for Northern White Pine. Sugar Maple and Beech forests lost 3·04 and 2·98 acre-inches respectively. Factors affecting the current transpiration of a particular tree were found to be light intensity, relative humidity, and time of day and season, while the factors to be considered in comparing the water losses from different forests are species make-up, the amount of foliage and its exposure, soil moisture, and the humidity level. *From Author's Summary.*

12. TREE SPECIES. FOREST BOTANY

12.11. Physiology. Biology

12.11.2 : 31.13 : 12.26.22. KNOWLSON, H. **A long-term experiment on the radial growth of the Oak.**—*Repr.* from *The Naturalist* 1939 (93–9).

Structural changes take place in the wood of earthed-up tree-trunks, and it develops the appearance and characteristics of root rather than stem tissue.

12.11.21 : 23.23.19. DENGLER, A., and SCAMONI, A. **Conditions for the germination of the pollen of forest trees.** *Zeitschr. F. u. J.* 71, 1939 (1–40). [G.g.]

Environmental factors affecting the germination of pollen of conifers and broad-leaved trees, such as nutritive medium, temperature, humidity, pre-germination treatment with heat, cold, and a stimulant ('Effusan'), mode and length of storage, &c., were studied to determine their separate and (sometimes) combined effects. It was found that the usual laboratory procedure of maturing anthers and conserving the pollen in tubes for several days did not diminish the germinative ability.

12.11.22.3 : 21.4 : 12.26.22. WOOD, O. M. **Relation of the root system of a sprouting stump in *Quercus montana* Willd. to that of an undisturbed tree.** *Jnl. For.* 37, 1939 (309–12).

The ability to regenerate by sprouts is an outstanding characteristic of many of the hardwoods of eastern America. The author attempts to find out the reaction of the root system of a Chestnut Oak (*Quercus montana* Willd.) after the tree has been cut and sprouting has started.

12.11.22.3 : 23.25 : 12.26.22. PETCUT, M. **The vitality of Oak roots.** *Rev. Padur.* 51, 1939 (135–49). [Rou.f.]

The power of roots of stumps to sucker after long periods of dormancy.

12.11.22.4. AFANASIEV, M. **Effect of indolebutyric acid on rooting of greenwood cuttings of some deciduous forest trees.** *Jnl. For.* 37, 1939 (37–41).

Cuttings of *Betula populifolia*, *B. papyrifera*, *Acer rubrum*, and *Populus alba*×*nivea* showed definite stimulation of root growth after treatment, but results with *Acer saccharum* and *Populus tremuloides* were negative. The most effective single treatment for individual species is shown in the following table.

It is believed that improvements in technique would raise the percentage of rooted cuttings considerably.

	Treatment		Rooted	
	Mg. of acid per litre	*Time (hours)*	*Per cent.*	*In days*
Betula populifolia .	5 or 10	6	30	68
„ *papyrifera* .	20	24	50	65
Acer rubrum . . .	20	24	60	77
Populus alba × *nivea*.	20	12	55	47

12.11.3 : 12.25.53. Götz. **Notes on Prof. Schmidt's article in *Der Deutsche Forstwirt* on 'Malformation and bad racial quality'.** *Allg. F. u. J.* 115, 1939 (8–20). [G.g.]

A severe criticism of Professor Schmidt's theory. The author suggests that phototropism and the tendency of forming coarse branches (Grobästigkeit) in *Pinus silvestris* are inherited independently. Therefore the determination of the degree of phototropism in seedlings by Schmidt's seedling-diagnosis, does not permit of conclusions as to the racial quality of the material examined.

12.12. Pathology

12.12 : 11.41 : 12.21.7 : 12.25.53. Toole, E. R. **Relation of incidence of needle disease in Loblolly Pine plantations to certain physical properties of the soil.** *Jnl. For.* 37, 1939 (13–18).

The incidence of infection by *Septoria acicola* and *Lophodermium pinastri* in young *Pinus taeda* plantations could not be related to height growth or to the seven physical properties of the soil that were studied. There was, however, a significant difference in amount of infection relative to the age of plantations: infection seemed most severe in the youngest stands of 2–3 years in age. The possible interaction of other site factors should be investigated.

12.12 : 47 : 12.26.53 (77.1). **Virus disease of Elms.** *Science* 89, 1939. Supplement, p. 6.

Epidemic outbreak in Ohio of a new disease caused by a filterable virus. 'During three years it killed more than 1,000 out of about 1,800 Elms in Chillicothe. . . . The symptoms are: first, a slight shrivelling and brittleness of the leaves; then a rotting of the roots and the inner bark of the trunk. Within a few months the tree may be dead.'

12.14. Morphology. Anatomy

12.14.3 : 12.25.53 : 12.19 : 21.4. Pessin, L. J. **Root habits of Longleaf Pine and associated species.** *Ecology* 20, 1939 (47–57).

Most of the root systems of Longleaf Pine seedlings grown under natural conditions were symmetrical, but in a number of cases old root-holes, charcoal pockets, and differences in soil texture had induced asymmetrical growth. The majority of the lateral roots were found to occupy the same stratum of soil as those of the associated grasses and herbs, so that critical competition for moisture might be expected during unfavourable climatic conditions. That such competition exists is shown by the marked growth of seedlings after removal of the surrounding grasses and herbs. The total absence or slow growth of Pine seedlings in the vicinity of clumps of *Quercus cinerea* is also explained by competition from the large root systems of seedlings of the latter species.

12.14.7 : 12.19 : 12.25.52 (43.7). Mezera, A. **On the distribution of cone forms of Spruce in Czecho-Slovakia.** *Lesnická Práce* 18, 1939 (35–60). [Cz.g.f.]

Taxonomic and ecological study of the varieties occurring in Czecho-Slovakia with detailed photographic material.

12.19. Geographical distribution. Plant Geography and Sociology. Regional floras

12.19. Deventer, W. C. van. **Studies on the ecology of secondary communities in a deciduous forest area.** *Ecology* 20, 1939 (198–216).

12.19 (66.9). Richards, P. W. **Ecological studies on the rain forest of Southern Nigeria:** I. The structure and floristic composition of the primary forest. *Jnl. Ecol.* 27, 1939 (1–61).

The Rain Forest of south-western Nigeria originally formed a belt, parallel to the coast, lying between lagoons and swamps to the seaward and a belt of Mixed Deciduous Forest. The development of agriculture has broken this Rain Forest into isolated blocks, many of which are now set apart as forest reserves. Most of the forest within these reserves is secondary or heavily depleted and timber exploitation is still being carried on in it. However, some small areas of the original primary forest still exist. This paper is concerned mainly with an intensive study of some of these relict areas. In the whole of south-western Nigeria the Rain Forest is near its climatic limits. The annual rainfall

varies from just over 1,600 mm. to over 2,600 mm., but during the dry season of 2 to 5 months there is less than 50 mm. of rain. Where the annual rainfall is less than 1,600 mm. the Rain Forest gives place to Mixed Deciduous Forest, though the variation in annual rainfall is not believed to be the basic factor determining the boundary between these types. During the investigation only two types of primary Rain Forest were met with, the Mixed Rain Forest, considered to be the climatic climax of the region, and the Fresh-water Swamp Forest, an edaphic climax conditioned by a high water table.

Sample plots were established in the Mixed Rain Forest, two on the Shasha Reserve and one on the Okomu Reserve, and studies were made with particular reference to: (*a*) Soil profiles which indicated that the soils belong to the Tropical Red Earth or Yellow Earth Types. (*b*) The stratification of forest, with aid of profile diagrams. Three fairly well-defined storeys of trees were recognized and beneath these rather ill-defined shrub and herb strata. (*c*) The synusiae of climbers and epiphytes. (*d*) The floristic composition of the forest showing a mixture of species without marked dominance of any one species. The composition differs considerably on the three plots, each representing what is probably a different facie of the same association.

A sample plot was established in an area of Fresh-water Swamp Forest in the valley of a small stream. The structure of this type differs from that of the Mixed Rain Forest chiefly in its greater irregularity. Thirty-six per cent. of the trees 16 in. diameter and over are of a species of *Mitragyna*. The majority of subsidiary species are also found in the Mixed Rain Forest. A brief discussion is given on the distribution, chief characteristics and status of the Mixed Deciduous Forest.

The chief differences between the Rain Forest of south-western Nigeria and that of British Guiana and Sarawak are reviewed. *From Author's Summary.*

12.19 : 04.5 : 09.7 (55.1). RECHINGER, K. H. Vegetationsbilder aus dem nördlichen Iran. **[Photographs of the vegetation of northern Persia.]** 1939. *Vegetationsbilder* 25, 5. [Plates 25–30].

12.19 : 11.21.3 (54.8). KRISHNASWAMY, K. **The montane evergreen forest, Bisale region.** *Ind. For.* 45, 1939 (189–201).

The Bisale State Forest, an evergreen forest, occupies an area of about 15 square miles in the south-western extremity of the Western Ghats of Mysore. Altitude ranges from 450 to 3,521 ft. Warmth and moisture are the factors determining the nature of growth; the humidity is very high, especially during the rainy season. Most of the growth takes place between the rainy season and dry season—from the 1st of October to the end of December. The flowering season corresponds to the driest season of the year—January to March. In general fruits ripen in May and June. Three principal zones of growth are: the semi-evergreen passing gradually on to the deciduous under 800 ft., and the evergreen zone from 800 to 2,500 ft., passing abruptly to the bare grassy hill-tops, over 2,500 ft. The evergreen flora shows two distinct associations of tree species, the *Dipterocarpus-Vateria* type and the *Vateria-Elaeocarpus* type, an edaphic variant of the former. The evergreen type is described in detail and a brief mention is made of the deciduous type. The ecological factors affecting tree growth in these forests and leading to the formation of the climax type of vegetation are discussed. *From author's summary.*

12.19 : 11.44 (43.15). WAGENKNECHT, E. **Research on the development of the vegetation after the removal of forest litter in a Brandenburg Pine forest.** *Zeitschr. F. u. J.* 71, 1939 (59–78). [G.]

On sites of medium quality, on diluvial sand, vegetation passed through the *Calluna* stage to the *Hypnum* stage and eventually to a climax determined by the conditions peculiar to each site.

12.19 : 11.49.8 (43.81). KOBENDZA, R. Goloborza i ich stosunek do lasu w górach Świętokrzyskich. **[Forest vegetation on screes in the Ste. Croix mountains.]** *Inst. Rech. For. Poland, Trav. & Comptes Rendus*, Ser. A, No. 43. 1939. pp. 76. [Pol.f.]

An explanation of the edaphic and climatic peculiarities of the screes is followed by an analysis of their cryptogamic flora. Where loess is found amongst the gravel, *Sorbus aucuparia* is the first tree species to establish itself, followed by *Picea excelsa*, under the canopy of which *Abies alba* finds favourable conditions for growth. Eventually the Fir forces both the *Sorbus* and Spruce trees to the periphery of the forest vegetation islets. *Vaccinium myrtillus* is the most typical representative of the ground vegetation in all the tree stands examined.

12.19 : 12.14.4(75.3). LAWRENCE, D. B. **Some features of the vegetation of the Columbia River gorge.** *Ecol. Mon.* 9, 1939 (217–57).

This includes a detailed description and discussion of the peculiar one-sided crowns of Douglas Fir and of other tree species in the western and eastern parts of the gorge.

12.19 : 23.1 (81). FREISE, F. W. **Observations on second-growth stands in the primeval forests of the coastal region of Brazil.** *Zeitschr. f. Weltf.* 6, 1939 (281–99). [G.g.e.f.]

Includes ecological and floristic data on second-growth stands on abandoned agricultural land. These stands, if left undisturbed, tend to be succeeded within a few decades by forest of a type similar to the virgin forest which existed before clearings were made. The aim of the forester should be to encourage the desired succession rather than to attempt the creation of one-species woods.

12.19 : 43. HEYWARD, F. **The relation of fire to stand composition of Longleaf Pine forests.** *Ecology* 20, 1939 (287–304).

A study of the stand composition of fire-protected and unprotected forests of Longleaf Pine (*Pinus palustris* Mill.) and Slash Pine (*P. caribaea* More.), over widely distributed areas, indicates that hardwoods have invaded practically all Longleaf Pine stands protected from fire, and that hardwoods are numerous in nearly all such stands of pole size or larger from which fires had been excluded for more than 10 years. Stands that have been subjected to repeated forest fires remain practically pure Pine.

12.19 : 97.1 (42). MATTHEWS, J. R. **The ecological approach to land utilization.** *Scot. For. Jnl.* 53, 1939 (23–34).

The importance of plant ecology in relation to the land problem in Britain and particularly as a guide to tree planting and forest development. The apparent close correlation of specific forest associations with soil types and topography and the use of lesser vegetation as indicators of possible woodland types.

12.19.1 (54.87). ABEYESUNDERE, L. A. J., and ROSAYRO, R. A. DE. **Draft of First Descriptive Check-List for Ceylon.** Imperial Forestry Institute, Oxford. *Check-Lists of the Forest Trees and Shrubs of the British Empire* No. 4. 1939. pp. 115.

12.19.2 : 12.26.22 (41.5). TURNER, J. S., and WATT, A. S. **The Oakwoods [*Quercetum Sessiliflorae*] of Killarney, Ireland.** *Jnl. Ecol.* 27, 1939 (202–33).

12.19.2 : 22.31. ZEDNIK, F. **On the structure of the primeval forests in the temperate zone.** *Zeitschr. f. Weltf.* 6, 1939 (215–29). [G.g.e.]

An attempt to reconcile the apparent contradictions in the various definitions of 'primeval forest' based on observations in the temperate zone. In the author's view these contradictions are due mainly to (1) disregard of the fundamental difference in structure between primeval forest of the shade-bearing and light-demanding types, and (2) the mistaking of the preliminary stages of development of the shade-bearing primeval forest for its final stage.

12.2. *Special (Systematic) Botany*

12.2 : 31 (67.6). EGGELING, W. J., and HARRIS, C. M. **Fifteen Uganda timbers.** *Forest Trees & Timbers of the British Empire* No. 4. Clarendon Press, Oxford. 1939. pp. 120.

A general and botanical description of the tree, a description of the wood as to physical and mechanical properties, macroscopic and microscopic characters, uses, and notes on distribution, ecology, natural regeneration, and silviculture of the following species: *Alstonia congensis* Engl., *Markhamia platycalyx* [Bak.] Sprague, *Cynometra alexandri* C. H. Wright, *Carapa grandiflora* Sprague, *Entandrophragma angolense* [Welw.] C.DC., *E. cylindricum* Sprague, *E. excelsum* Sprague, *E. utile* Sprague, *Khaya anthotheca* [Welw.] C.DC., *K. grandifoliola* C. DC., *K. senegalensis* [Desr.] A. Juss., *Lovoa brownii* Sprague, *Chlorophora excelsa* [Welw.] Benth. & Hook. f., *Dalbergia melanoxylon* Guill. & Perr., *Maesopsis eminii* Engl.

12.21 (4). KNAUTH, B., and NEUHOFF, W. Die Pilze Mitteleuropas: Band II. [*a*] Die Gallertpilze [*Tremellineae*], [*b*] Die Milchlinge [*Lactarii*]. [**The fungi of Central Europe:** Vol. II. *Tremellineae* and *Lactarii*.] Verlag von Dr. Werner Klinkhardt, Leipzig. 1939. pp. 25–32 and plates.

12.21 : 44.3. GARRETT, S. D. **Soil-borne fungi and the control of root disease.** *Tech. Comm.* No. 38. Imperial Bureau of Soil Science, Harpenden, England. 1939. pp. 54.

12.21 : 44.3 : 47. HADDOW, W. R. **The disease caused by *Trametes pini* [Thore] Fries in White Pine [*Pinus strobus* L.].** *Roy. Canad. Inst. Trans.* 22, 1938 (21–80).

The disease is non-lethal yet very destructive and is of widespread distribution. Normally it causes heart rot in the middle portion of the trunk, and is also often responsible for decay in old trees. Detection is possible mainly through the occurrence of 'punk knots' and associated symptoms. Proposals for its control include substitution of resistant for susceptible species, preservation of natural resistance at a maximum, development of mixed stands, introduction of a short rotation, sanitation fellings and thinnings, close utilization, and disposal of waste. These proposals are reviewed critically, and the 'pathological rotation' is discussed. [Condensed from *Expt. Sta. Rec.* 80, Jun. 1939: 791.]

12.21: 44.3 : 47. MACDONALD, J. A. ***Coniophora puteana*. [Schum.] Karst. on living *Sequoia gigantea*** *Ann. Appl. Biol.* 26, 1939 (83–6).

The fungus was isolated and identified from a 36-year-old tree felled in a garden at St. Andrews, Scotland, in 1936. This is believed to be the first record of a *Coniophora* on *S. gigantea*, and as the fungus was the only organism present, it clearly acted as a primary parasite. The rot produced in culture and in nature was characterized by horizontal cracks in the wood. Artificially infected blocks of the wood lost approximately 17 per cent. of their weight through the activity of the fungus. [Condensed from *Rev. Appl. Mycol.* 18, 1939: 425.]

12.21.7 : 44.3 : 47 (43.71). KALANDRA, A. **The first appearance of the *Rhabdocline* leaf-cast of Douglas Fir in Sudetenland.** *Ochr. Rostl.* 15, 1939 (36–40). [Cz.g.]

12.25.51–52 (44.48). MARTIN, J. J. E. **Silver Fir and Spruce: the Silver Fir in the Savoie Alps.** *Rev. E. & F.* 77, 1939(113–19). [F.]

Distribution as influenced by temperature and grazing.

12.25.53 : 12.11.3. SEITZ. **Our 'True Pines'.** *Mitt. d. Dendr. Ges.* 51, 1938 (67–72). [G.]

Races of *Pinus silvestris* in Germany.

12.25.53 : 12.19 (43.3). PODHORSKY, J. **Erect forms of *Pinus montana* in the Eastern Alps.** *Schweiz. Zeitschr. Forstw.* 90, 1939 (105–21). [G.] *Repr.* from *Wien. F. & J. Ztg.* 3 & 4, 1939.

Distribution, ecology, and growth.

12.26.22 [44.88]. SALVADOR, J. **Beech in the Pyrenees, with special reference to the Pyrenees of Ariège.** *Rev. E. & F.* 77, 1939 (101–12). [F.]

Notes on distribution, silviculture, and utilization.

12.26.32 : 23.24.1 (42). WITT, A. W. **Walnuts.** *Quar. Jnl. For.* 33, 1939 (6–13).

The work on walnuts at East Malling Research Station from 1929 to 1937 is reviewed. Notes on propagation and pollination are given, and a method of producing small garden trees is mentioned. The varieties in the East Malling collection are mentioned and brief descriptions are given of the more important ones. *Author's summary.*

12.29.81 : 33.8 (922). SCHREUDER, E. J. **The Nibong [*Oncosperma filamentosum* Bl.] problem in Bengkalis.** *Tectona* 32, 1939 (165–90). [Du.g.]

Report on Government measures to prevent the exhaustion of supplies of Nibong timber which is essential to the well-being of local fishing communities in the construction of *djirmal* fish-traps.

13. FOREST ZOOLOGY

13.21.85.67.1 : 12.28.47 : 47 (922). KALSHOVEN, L. G. E. **A longicorn borer in living and dead Teak trees: *Monohammus rusticator* Fab., Fam. *Lamiidae*.** *Tectona* 32, 1939 (321–37). [Du.e.]

This borer is considered of minor importance to the cultivation of Teak in Java. The insect suffers from a high mortality in the larval stage, due mainly to an infectious disease, and the infestation of living bark occurs only where rain is plentiful and well distributed throughout the year. Up to 38 per cent. of the trees in a stand may show traces of larval galleries in the bark and slow-growing trees appear to be relatively more susceptible to attack.

13.21.85.81.3 : 45.3 (43). OLBERG. **The significance of the Pine-shoot Tortrix in the raising of first-class Pine timber.** *Forstarchiv* 15, 1939 (29–30). [G.]

The author suggests that the detrimental effect of the moth on the quality of timber is such as to justify more intensive control measures than those hitherto employed.

2. SILVICULTURE

21. SILVICULTURAL CHARACTERS

21.2 : 21.4 (91). WILKINSON, G. **Root competition and silviculture.** *Mal. For.* 8, 1939 (11–15).

Root competition for moisture may occur even under the high rainfall conditions characteristic of Malaya. To minimize such competition the silviculturist should avoid growing in close proximity tree species whose roots compete in the same soil layer. So far very few data are available on the root growth of Malayan trees. A summary is given of the author's observations on the root systems of poles of a number of species in Bongsu and Gunong Jerai forest reserves.

21.3 : 11.47.13 : 12.26.21. NĚMEC, A. **The nutrition of Alder on poor soils.** *Lesnická Práce* 18, 1939 (26–35). [Cz.g.]

Experiment shows that *Alnus glutinosa* will not develop properly on degraded soils deficient in lime and with a pan formation in the B-horizon without first liming and manuring. The best response was obtained after manuring with limestone sediments (Kalksteinsedimente) containing magnesia, dibasic calcium phosphate, and calcium nitrate.

22. SYSTEMS OF MANAGEMENT. FORMS OF STAND

22.14. HUFNAGL, L. **The economic aim, normal form, and management of the selection forest** [concld.]. *Centralbl. f. d. g. Forstw.* 65, 1939 (82–92). [G.]

A general survey of the subject. The reliability of comparisons of value and yield of selection and even-aged forests is questioned and the view is expressed that conversion of an even-aged forest into a selection forest should not be decided upon except in very special circumstances.

22.56 : 42.21. HOWARD, S. **Effect of standards on field crops in *taungya*.** *Ind. For.* 65, 1939 (151–2).

A note on a case of prohibitive reduction in the yield of field crops in *taungya* due to competition from overwood established as protection against frost.

22.6. BOCHET. **The conversion of coppice and of coppice-with-standards to broad-leaved high forest: is it practicable for owners of small forests?** *Rev. E. & F.* 77, 1939 (23–35). [F.]

The question applies to small forests in both communal and private ownership. Owners of small forests should aim at converting coppice and coppice-with-standards to broad-leaved selection, rather than even-aged high forest, whenever this is practicable, as the conversion to selection forest is quicker and involves less financial sacrifice during the period of transition. In most cases Beech will have to be the dominant species in the selection forest.

22.8 : 41. **The relation of stand composition to crop security:** Report of the Committee on Silviculture, New England Section, Society of American Foresters. *Jnl. For.* 37, 1939 (49–54).

While the climax forest should be invariably used as a guide to a workable combination of species and great caution should be taken in the introduction of exotics and the formation of pure stands, it is possible to develop mixtures which are more profitable than those occurring under natural conditions without sacrificing crop security. In some cases, strict adherence to the climax forest has even become impracticable as a result of the introduction of foreign insect pests and diseases. For example, the Chestnut, for many centuries a prominent element in southern New England forests, has been destroyed by the introduced Chestnut Blight (*Endothia parasitica*). The pathological principles outlined by the Committee, and particularly its warning regarding the introduction of exotic conifers, are endorsed by Dr. J. S. Boyce, whose note is appended to the report.

23. FORMATION OF STANDS

23.1. *Natural Formation of Stands*

23.1. VANSELOW, K. **Age, composition, and structure of stands of natural regeneration.** *Allg. F. u. J.* 115, 1939 (39–50). [G.]

The technique for studying natural regeneration on ecological lines by means of sample plots is described with the aid of tables and diagrams. Included are observations on stand composition, height, age, stem form, probable survival, damage due to browsing, &c.

23.1 : 56 (71). SISAM, J. W. B. **Forest development on the Goulais Watershed 1910–33.** *Dominion Forest Service Silvicultural Research Note* 55. Ottawa. 1939. pp. 55.

Two townships on the Goulais river water-

shed, Algoma district, Ontario, cut over for pulpwood in 1910, constituted the basis for a study of cut-over lands to determine the rate at which they are restocking. Two detailed surveys were made, one in 1920 and one in 1927. A series of permanent plots were established in 1928 and remeasured in 1933. The following conclusions are drawn:

1. In mixedwood stands high mortality of Balsam Fir following cutting ceased about 1920. Net annual increment per acre of 5·7 cu. ft. previous to 1920 was increased to 15·8 cu. ft. by 1933.
2. In the softwood type, mortality, following cutting, was not so severe. The net annual increment increased from 7·2 cu. ft. during 1917–20 to 19·9 cu. ft. during 1920–7, and in 1928–33 amounted to 45·4 cu. ft.
3. Probable yield by 1940, 30 years after cutting, will be 450 cu. ft. per acre, 4 in. d.b.h. and over, in the mixedwood type, and 850 cu. ft. in the softwood type.

23.23. Sowings. Seed planting

23.23.13.11 : 12.25.53. LeBarron, R. K., and Eyre, F. H. **The release of seeds from Jack Pine cones.** *Jnl. For.* 37, 1939 (305–9).

The cones of Jack Pine (*Pinus banksiana*) do not naturally release their seed when mature. A study over a period of 29 months showed that cones on lopped and scattered branches yield 9 times as many seeds as cones on felled trees and 100 times as many seeds as from girdled trees. Most of the seeds were released in July and August. The two conditions which appear necessary for proper opening of the cones are low precipitation and high temperature.

23.23.15 : 12.26.53 (73). Barton, L. V. **Storage of Elm seeds.**—Experiments in America. *Contrib. Boyce Thompson Inst.* 10, 1939 (221–33).

A comparative study of different methods of storage and pre-germination treatment of the seed of *Ulmus americana* L. The seeds can be kept viable for at least 16 months by sealing in containers kept at 5° C. or lower.

23.23.19. Baldwin, H. I. **Some new aspects of seed certification.** *Jnl. For.* 37, 1939. (28–36).

Certification of imported and home-grown forest tree seed is considered. The only useful basis for certification is the seed itself and the certainty that it will produce the type of plants desired. Seed that is to be certified should be collected from local indigenous races only, where both parents are of the same race. The collection of seed from planted or non-indigenous stands is discussed, and the value of certification of geographical origin only is questioned. The basis for certification of origin, race, purity, and germination is discussed and consideration is given to costs of certification and the obstacles to its application. *From author's summary.*

23.23.19. Dunlap, A. A., and McDonnell, A. D. **Testing germination in sand.** *Jnl. For.* 37, 1939 (330–2).

A new method for testing the germination of tree seeds. A 7-in. flower pot is nearly filled with fairly coarse, clean sand, thoroughly wetted, and placed in shallow container with about 1 in. of water. A definite number of seeds are placed on the sand surface and covered with one-eighth to one-fourth inch of sand.

23.23.19. Hao, K. S. **On seed testing by biochemical methods.** *Zeitschr. F. u. J.* 71, 1939 (141–56 : 187–204 : 249–69). [G.]

Using the seed of Fir (*Abies pectinata*), Douglas Fir, and species of Pine and Spruce, tests were made on 22,800 seeds using Nelubov's indigo-carmine method and on 21,700 seeds using Eidmann's sodium-biselenite method. The results in both cases were compared with those of ordinary germination tests. Nelubov's method was found to be very satisfactory. According to the author it is preferable to Eidmann's method, the results from which are influenced to a greater extent by subjective interpretation and accidental factors. Moreover, the indigo-carmine method is more rapid and does not involve the handling of poisonous selenium salts. Neither method appeared to be influenced by the pH value of the colour solution, but in Eidmann's test the intensity of colour increased with the sulphur content of the embryos.

23.23.19. Krzeskiewicz, W. Określenie potencjalnej zdolności kielkowania nasion sosny za pomoća metody barwienia. [**Determining the viability of Pine seeds by means of the indigo-carmine colour test.**] *Inst. Rech. For. Poland Trav. & Comptes Rendus* Ser. A, No. 44. 1939. pp. 45. [Pol.g.]

The test as devised by Nelubov is based on

the property of indigo-carmine to give dead and dying tissue a blue colour. Sample lots of 400 seeds are soaked in water for at least 3 hours, after which the embryos are extracted. The embryos are then placed in a 1 : 2,000 solution of indigo-carmine for 1 to 2 hours at room temperature. The colour solution is then decanted and the embryos rinsed twice with distilled water. Embryos are assumed to be capable of germination when they have remained entirely white, when the root cap is coloured to an extent not exceeding ¼ of the total length of the embryo, and when only part of the cotyledon is coloured. It is shown that Nelubov's method is as reliable in determining the viability of Pine seeds as either the germination test or Eidmann's selenium method (cf. *Forestry Abstracts*, Vol. I, No. 1, p. 35). Compared with the latter, the indigo-carmine test has the advantage of being less expensive and more rapid, requiring only 6 hours instead of 3 days.

23.23.19. Laurie, M. V. **Germination of Nim seed** [*Azadirachta indica*]. *Ind. For.* 65, 1939 (104–6).

In an experiment at the Forest Research Institute, thorough removal of the skin and pulp of Nim seed improved its germinative capacity almost five-fold as compared with uncleaned seed, while intermediate results were obtained with seed that had been roughly cleaned.

23.23.19. Parras, V. **Comparison of different methods of germinating Bitaog** [*Calophyllum inophyllum* **L.**] *Philip. Jnl. For.* 2, 1939 (57–62).

The seed of Bitaog (*Calophyllum inophyllum* L.) has a thick shell which delays germination. Experiments were undertaken in 1927, 1928, and 1930 to find some method of overcoming this condition. Three methods were tried: (1) application of cogon mulch to the seed bed, (2) cracking the shell of the seed, and (3) complete removal of the seed shell. The last treatment was found to be the most effective with the following results: (*a*) the average time seed remains in the soil before germination starts was reduced from 57 days to 22 days; (*b*) the average length of germinating period for all seed was reduced from 53 days to 39 days; and (*c*) the average germination was raised from 63 to 93 per cent.

23.23.19 : 11.46.8 : 11.47. Bornebusch, C. H. **The germination of forest seeds.** *Dansk Skovf. Tids.* 1, 1939 (1–26). [Da.]

In the principal experiment, plots were laid out in different kinds of woodland on eight different soil type and sown with seed of a variety of forest trees. Each plot was subdivided into separately treated sections, the treatments including hoeing and digging, removal of surface soil, covering with sand, liming, and fallowing. Table I is extracted from the more detailed tables of the original, which give

Table 1. *Number of seedlings* (1 *summer old*) *in per cent. of number of seeds sown* (*average for all treatments*)

Soil type	*Average of deciduous trees*	*Average of conifers*	*Average of deciduous trees and conifers*
Circaea mull	8·6	4·7	6·7
Anemone mull	15·4	4·3	9·9
Oxalis mull	12·9	6·6	9·7
Spruce mull	11·0	7·2	9·1
Impoverished Beech soil (good natural seed-bed)	19·3	9·1	14·2
Beech mor in Rude Skov	16·2	1·9	9·0
Beech mor in Grib Skov	2·5	4·0	3·3
Spruce mor in Grib Skov	3·2	5·2	4·2

the germination results in full. Although a caution is given against attaching too much weight to individual figures, which vary widely and are open to several objections, it is claimed that the tendency to differential germination is sufficiently clear.

The effect of preparatory soil treatment varied greatly with the type of soil. On all deciduous forest soils cultivation increased the number of seedlings obtained. Except in the case of '*Circaea* mull', deep cultivation almost always decreased germination or was at all events unnecessary. A further disadvantage of deep cultivation was that it encouraged the growth of weeds and grasses. Shallow hoeing appeared to be the most suitable type of cultivation, and fallowing was found to be just about as effective.

On the mulls liming decreased the number of conifer seedlings and left the deciduous trees unaffected, while on mors it had an all-round beneficial effect. Removal of the surface soil or covering with sand gave satisfactory results on

the mors, but neither method was as good as combined hoeing and liming. Table 2 shows the effect of these treatments on the pH of the soils.

TABLE 2. pH *of soils as affected by various methods of treatment*

Treatment	*Circaea mull*	*Anemone mull*	*Oxalis mull*	*Spruce mull*	*Impoverished soil*	*Beech mor, Rude Skov*	*Beech mor, Grib Skov*	*Spruce mor, Grib Skov*
Undisturbed	5·2	5·0	5·0	4·5	4·6	4·0	3·8	4·1
Hoed to 5 cm. depth	5·5	4·8	4·9	4·5	4·5	4·1	3·8	4·0
Hoed to 15 cm. depth	5·7	4·8	4·4	4·3	4·5	4·0	3·8	4·3
Dug to 30 cm. depth	5·3	4·5	4·4	4·1	—	—	—	—
Covered with sand	—	—	—	—	4·2	4·0	3·8	4·0
Surface soil removed	—	—	—	—	4·4	4·0	4·0	3·8
Fallowed	5·1	4·2	—	4·2	4·4	3·9	—	—
Loosened and limed	6·0	5·9	6·8	4·9	5·9	5·2	5·7	6·4

The paper concludes with short notes on the survival of seedlings after 2 and 5–6 years. Survival was best on the *Anemone* mull and worst on the Beech mor in Grib Skov.

23.23.19 : 12.11.3. ROHMEDER, E. **The relative growth of young trees raised from different sizes of seed.** *Forstw. Centralbl.* 61, 1939 (43–59). [G.g.]

The influence of size of seed on the growth, as measured by height and weight, of 3-year-old Spruce seedlings, was pronounced in the descendants of only a few of the stems which had furnished seed for the experiment. Hereditary factors appeared to be much more important than size of seed. It was not possible, however, to correlate these factors with the phenotype of the seed-bearers.

23.23.19 : 12.11.3. VICENT, G. **The variability of conifer seeds and of the plants raised from them.** *Forstw. Centralbl.* 61, 1939 (250–5). [G.]

The author's researches on Czechoslovakian conifers lead him to the following conclusions:

a. Seed weight and the number of sound seeds are greatest in the middle third of the largest cones. The size of seedlings in the initial stages of growth is directly affected by seed weight: seeds from the middle portion of the largest cones gave the largest seedlings.

b. Maximum cone length was reached at 40–100 years by Spruce, and at 60–100 years by Silver Fir. Both species produced their heaviest seeds at 60–100 years. These differences could not be followed in the seedling progeny, but it is possible that they may be detected with more delicate methods of observation.

c. In Spruce, cone length, seed weight, and initial stature of the progeny all decreased with increasing elevation of the seed-bearers above sea level.

23.23.19 : 12.25.52 (43). ROHMEDER, E., and CHEN, C. Y. **Germination tests with Spruce seeds of different sizes.** *Forstw. Centralbl.* 61, 1939 (177–84). [G.g.]

In experiments conducted near Munich no essential difference could be detected between the germination of seeds of different sizes collected from the same tree either in the same or in different seed years, except that occasionally the germination of large seed was inferior and somewhat slower. In general the proportion of seed coat to seed content by weight was 3 : 7.

23.23.19 : 23.23.13.2. RIETZ, R. C. **Influence of kiln temperatures on field germination and tree per cent. in Northern White Pine.** *Jnl. For.* 37, 1939 (343–4).

Treatment of cones at 140° F. and 40 per cent. relative humidity for a period up to 12 hours did not reduce seed viability, though treatment at 160° F. for 8 hours or longer was detrimental.

23.24. Formation of crops by planting

23.24.2 : 12.11.2 : 12.25.53. STEVENSON, D. D., and BARTOO, R. A. **The effect of spacing on the growth of Norway Pine plantations.** *Jnl. For.* 37, 1939 (313–19).

Four plantation sample plots of Norway Pine [*Pinus resinosa*] were established in 1921 on comparable sites and the spacing of the plants was varied for each plot as follows: 5×5, 6×6, 6×8, and 10×10 ft. Measurements of the trees in these plots taken in 1937 show that: (1) The tendency to natural pruning increases with density of planting and consequent early closure of crown. (2) Diameter increment increases significantly with increase of spacing. (3) Height growth tends to increase with increase in spacing,

but this is not significant until the height growth of trees spaced 10×10 ft. is compared with that at any other spacing. (4) The diameter of branches 3½ ft. from the ground is much larger in the case of trees spaced 10×10 ft. than of those at any other spacing. (5) The trees spaced 10×10 ft. have more taper than those at any other spacing. (6) The basal area appears to increase at a faster rate for the trees at 10×10 ft. spacing than for those spaced more closely.

23.24.8 : 23.23.3 (43.6). WABRA, A. **Planting immediately beside old stumps:** a tested means of afforestation in Sudetenland. *Forst-archiv* 15, 1939 (156–7). [G.]

In clear-cut areas infested with weeds, seedlings of valuable species have a much higher chance of survival when planted or sown immediately beside old stumps, where edaphic and microclimatic conditions are particularly favourable.

23.25. Formation of crops by vegetative means

23.25.1 : 12.11.2. THIMANN, K. V., and DELISLE, A. L. **The vegetative propagation of difficult plants.** *Jnl. Arn. Arb.* 20, 1939 (116–36).

A study of the vegetative propagation of some coniferous and deciduous trees which root from cuttings only with great difficulty. It was determined that the ease with which roots are formed, on cuttings of 1-year wood, falls off steadily with increasing age of tree, whether the cutting is treated with auxin or not. Cuttings taken from trees 3–4 years old and treated with the optimal concentration of indole-acetic acid, or other auxin, give excellent rooting for the species *Pinus strobus*, *Picea abies*, *Quercus borealis*, *Acer platanoides*, and to a less extent *Fraxinus americana*. The optimum concentration of auxin, using aqueous solution applied to the base for 24 hours, varies with material between 25 and 400 mg. per litre. In *Pinus* and *Picea* lateral shoots root more readily than terminal shoots, and in *Quercus* and *Acer* the bases of the young plants root more readily than the apices. Sugar solution applied to pine cuttings, after treatment with auxin, increased the percentage rooting and decreased the mortality rate. In some conifers, notably *Tsuga canadensis* and *Picea pungens*, cuttings from old trees root exceedingly well if treated with auxin but do not root at all without treatment. The application of high concentration of auxin to the bases of cuttings frequently inhibits development of the buds, sometimes for several weeks. In other cases it may cause killing of the base, but this does not necessarily interfere with good root formation. *From author's summary.*

23.26. Plant rearing. Nursery practice

23.26 : 12.27.56 (54.5). CHOPRA, R. S. **Harar [*Terminalia chebula*] cultivation in the Punjab.** *Ind. For.* 65, 1939 (126–9).

Ripe seed should be collected soon after falling from the tree, then dried in the sun, the hardened fleshy cover removed, and the stone buried in 1 in. of clayey loam or sandy loam early in the spring. The plants are put out in the rainy season of the following year. This species is a light demander and will grow where the rainfall is over 25 in., where maximum shade temperature varies from 90° to 118° F. and minimum from 30° to 60° F. It is frost-hardy and drought-resistant to a high degree.

23.26.7 : 45.3 : 13.21.85.63.3. MITCHELL, H. L. **Preliminary notes on a method for the prevention and control of white grub infestations in nursery soils.** *Black Rock Forest Papers*, 1 (14), 1939. pp. 2.

A series of tests showed that a solution of 0·8 per cent. acetic acid, applied at the rate of 0·75 quart per square foot of seed-bed, is effective in controlling white grub infestation both before sowing and during the growing season. This treatment does not appear to harm after-ripened seed of White Pine.

23.26.9 : 11.47.13 : 12.11. NĚMEC, A. **The effect of partial phosphate fertilizing on the nutrition of Pines in forest nurseries.** V. *Sborn. Čsl. Akad. Zeměd.* 13, 1938 (649–57). [Cz.g.]

Uptake of manganese depended on soil acidity and the amount of soluble magnesia in the soil, and it increased with increase in the CaO+MgO content of the soil. [*Soils & Fertilizers* 2, 1939: 109.]

23.3. *Afforestation*

23.3 (45.9). BASSI, V. **Present technique of afforestation work in Sardinia.** *Riv. For. Ital.* 1, 1939 (15–26). [It.]

23.3 (73). PRESTON, J. F. **Results of the Soil Conservation Service program of planting trees and shrubs.** *Jnl. For.* 37, 1939 (19–22).

So far the Soil Conservation Service has afforested an area of about 217,500 acres, much of which consists of poor planting sites. While some mistakes had been made in the selection of tree species for planting, about 80,000 acres out of 110,000 acres recently examined showed a satisfactory survival.

23.3 : 42.31 : 38.63 : 11.63 (54.2). STRICKLAND, C. **Afforestation for the control of malaria.** *Jnl. R. Soc. Arts* 87, 1939 (502–6).

To improve natural moisture conditions on the dry hill-type in Bihar, and to prevent too rapid run-off of rainfall and consequent flooding, an irrigation experiment was undertaken using a system of dams and contour trenches. Improvement in forest growth and regeneration has resulted and beneficial changes in local meteorological conditions have been noted. It is believed that these environmental changes may lead to a local decrease in malaria. For example the anopheline mosquitoes are not tolerant of shade.

23.32 : 42.4 (486.7). PETRUS. **Afforestation in Skåne.** *Skogen* 26, 1939 (3–6). [Sw.]

Reclamation of poor sandy land and its protection from drifting sand.

23.38 (494.2). BORNAND, G. H. **Afforested areas on the Vaudois shore of the Lac de Morat.** *Jnl. for. suisse* 90, 1939 (9–14). [F.]

The areas are on the sites of lakes the levels of which have been artificially lowered.

24. EDUCATION OF STANDS. TENDING. THINNING

24 (71). MULLOY, G. A. **Forest improvement cutting in Canada.** *Dominion Forest Service Silvicultural Research Note* 56. Ottawa. 1939. pp. 22.

Under a special Conservation vote of the Dominion Government funds were provided for improvement cuttings, release and sanitation cuttings, and pruning on the various forest experiment stations. The object of this appropriation was to provide work for the labouring class, some of whom were on relief. The larger part of the men were unskilled axe-men. Costs of these intermediate cuttings were kept and may be taken as indicative of the possibilities of doing this work on a large scale. In each case a small local market existed. Some deductions are as follows:

1. It appears easier to plan and carry out thinnings that will pay for themselves or will entail a small net cost, in 30–40-year-old stands than in those 60–70 years old. In the former case there are nearly always larger trees which can be logged at a profit and benefit the stand. In older stands the cost of removal is greater and the benefit less.
2. At Petawawa (Ontario) the stands are about 60 years of age. Even the cheapest operation cost $1·15 per cord net. This is in mixedwood stands. At Acadia (New Brunswick), where the mixedwood stands are about 30 years of age, better results were obtained, sometimes even a net profit being made on the thinnings. At Kananaskis (foot hills of Alberta) dense 70-year-old Lodgepole Pine stands can be thinned at a profit. The market, however, is limited.

24 : 24.3 : 23.11 : 12.25.53 (73). PESSIN, L. J. **Density of stocking and character of ground cover as factors in Longleaf Pine reproduction.** *Jnl. For.* 37, 1939 (255–8).

Experiments at the Southern Forest Experiment Station with 12-year-old trees showed that the removal of herbaceous cover results in a marked increase in height growth, which can be further augmented by reducing the density of stocking. Poor growth frequently observed under field conditions is ascribed to excessive root competition for nutritive elements, and it is suggested that in such cases removal of herbaceous cover from an area 2–3 ft. around stunted seedlings would be a paying proposition.

24.2 (498). DEMETRESCU, I. C. **A frequent fault of thinnings in Roumania.** *Rev. Padur.* 51, 1939 (22–9). [Rou.f.]

The fault is in opening the stands to an extent that allows wind penetration. This may have serious results as soil and atmospheric humidity in the Roumanian plain are generally at the minimum required by forest vegetation. The author suggests the advisability of intervening at once to correct past errors in this

respect by means of plantations along the borders of the open stands.

24.2 : 07.7. OSBORNE, J. G. **A design for experiments in thinning forest stands.** *Jnl. For.* 37, 1939 (296–304).

The description of an experimental design with an example of its application.

24.23 : 12.25.53. REYNOLDS, R. R. **Improvement cuttings in Shortleaf and Loblolly Pine.** U.S.D.A. Forest Service. *Occasional Paper* No. 81. Southern Forest Experiment Station. 1939. pp. 4.

Such cuttings are shown to be economically justified.

24.23 : 45.3. LEXEN, B. R. **An experiment in the use of sodium arsenite in thinning Ponderosa Pine.** *Jnl. For.* 37, 1939 (259–62).

From an experiment with 300 trees, conducted by the South-western Forest and Range Experiment Station, it appears that two injections of 25 c.c. of solution, each containing the equivalent of 4 grammes of As_2O_3 are ample to kill trees up to 12 in. diameter. The injections are made in two $\frac{3}{4}$-in. holes, each 5 in. deep and 2·5 ft. above ground, on opposite sides of the tree, and at an angle of 45°, or else inward from the tangential just enough to keep the incisions within the bole. The advantage of eliminating undesirable trees with poison arises from the fact that, for some reason as yet unexplained, trees so killed have either resisted or escaped the customary attack of *Ips*.

24.25. BORNEBUSCH, C. H. **The influence of intensity of thinning upon dimensions and rotation.** *Dansk. Skovf. Tids.* 3, 1939 (149–60). [Da.]

In Danish stands of Norway Spruce on relatively good soils, light thinnings with a somewhat prolonged rotation gave a better assortment of useful dimensions of timber and would therefore appear to be the most advantageous from the point of view of production.

24.25 : 12.28.47. HELLINGA, G. **Natural thinning in unthinned Teak plantations.** *Tectona* 32, 1939 (290–308). [Du.du.e.]

The initial number of trees per hectare in plantations of different spacing varied from 2,500 to 5,000. After a period of 20 years natural mortality had reduced these numbers to approximately 1,300 to 1,800 trees per hectare. At the same age the better sites tend to grow relatively fewer trees than do poor sites. Yield studies of 21 Teak sample plots, which were left unthinned since their establishment 20 years ago, showed that the mean basal area diameter was only 70 to 95 per cent. of that of normally thinned plantations; that the number of trees per ha. was 50 to 250 per cent. more, and the total basal area per ha. 50 to 100 per cent. more than under normal conditions of thinning. The total tree volume per ha. of the unthinned plots was 20 to 80 per cent. more than the total tree volume of the remaining stand and 5 to 25 per cent. less than the total tree volume of the total stand (remaining stand plus thinnings) of normally thinned plantations. There was very little difference (only 2 to 10 per cent.) in the weighted mean height of the thinned and unthinned plantations. *From Author's summary.*

24.3 (43). ZENTGRAF, E. **Management for light increment.** *Allg. F. u. J. Ztg.* 115, 1939 (112–19). [G.]

A survey of German literature on the subject with detailed bibliography. Management for light increment does away with the harmful effects of over-cutting.

24.36.5 : 23.1 (91). STRUGNELL, E. J. **Developments in hardwood regeneration.** *Mal. For.* 8, 1939 (53–6).

A heavy cleaning of the regeneration of primary hardwoods, above 2·5 ft. in height, resulted in the swamping of all growth by climbers within 6 months. It was found necessary to retain an overhead canopy of Meranti [*Shorea* spp.] or other nurse trees, thinned where necessary, to prevent creeper invasion. To initiate hardwood regeneration a light preliminary operation is advocated such as the girdling of unmarketable species up to 3 ft. in girth. A second operation would be necessary to induce rapid growth. A preliminary felling of part of the main crop of hardwoods may be of advantage to regeneration development.

24.41 : 91.3 (78). DURREL, G. R. **Social and economic effects of the Great Plains shelterbelt in terms of soil and human betterment.** *Jnl. For.* 37, 1939 (144–7). Conf. ppr.

31. PROPERTIES OF WOOD

31 : 12.26.22. **Common Beech.** *Holz* 2, 1939 (95–6). [G.]

Table of characters and properties of *Fagus sylvatica*, compiled at Eberswalde.

31 : 12.26.22. **Durmast Oak.** *Holz* 2, 1939 (47–8). [G.]

Table of characters and properties of *Quercus sessiliflora*, compiled at Eberswalde.

31 : 12.26.32. **Hickory.** *Holz* 2, 1939 (127–8). [G.]

Table of characters and properties compiled at Eberswalde.

31 : 12.27.32. **Bongosi.** *Holz* 2, 1939 (45–6). [G.]

Table of characters and properties of Red Ironwood (*Lophira procera* A. Chev.), compiled at Eberswalde.

31 : 12.28.61. **Common Ash.** *Holz* 2, 1939 (125–6). [G.]

Table of characters and properties of *Fraxinus excelsior* L., compiled at Eberswalde.

31 : 33 : 12.25.53 (494). DARBELLAY, J. **Technological notes on the Weymouth Pine.** *Jnl. for. suisse* 90, 1939 (50–5). [F.]

The properties of the wood and its utilization in Switzerland.

31.1. *Form. Size. Structure*

31.13 : 12.27.72 (94). DADSWELL, H. E., and ELLIS, D. J. **The wood anatomy of some Australian *Meliaceae*, with methods for their identification.** *Austral. C.S.I.R. Bull.* No. 124. Govt. Printer, Melbourne, Australia. [*Div. of For. Prod. Techn. Paper* No. 31.] 1939. pp. 20.

A description of the wood structure together with notes on occurrence and the general properties of the timbers of the following species: *Amoora nitidula* Benth., *Carapa moluccensis* Lam., *Cedrela toona* Roxb. var. *australis* C. DC., *Dysoxylum fraseranum* Benth., *D. muelleri* Benth., *D. rufum* Benth., *Melia dubia* Cav., *Owenia venosa* F. v. M., and *Synoum glandulosum* A. Juss. A key for the identification of these species is included.

31.13 : 31.22 : 12.14.2. GREISS, E. A. M. **Effect of water supply on the structure of the xylem elements in certain trees in Egypt.** *Repr.* from *Bull. Inst. Egypte* 20, Session 1937–8 (193–225). Imprimerie de l'Institut Français d'Archéologie Orientale, Cairo. [E.]

This preliminary study is based on branch material of three species, *Eucalyptus rostrata*, *Morus alba*, and *Acacia arabica* var. *nilotica*, grown under wet and dry conditions. Under wet conditions the vessels are fewer but wider than under dry conditions. The growth rate under wet conditions increased markedly in *Morus*, less in *Eucalyptus*, and hardly at all in *Acacia*; specific gravity also showed an increase under wet conditions in *Morus* and *Eucalyptus*, but not in *Acacia*. Other features studied were vessel pitting, demarcation of rings, proportion of rays and parenchyma, zones of sclerenchyma, rows of protoxylem and metaxylem, and lignification.

31.13–4 : 12.28.55. MILANEZ, F. R. **An anatomical study of the wood of thirty species of the genus *Aspidosperma*.** *Repr.* from *Physis* [*Rev. Soc. Arg. Cienc. Nat.*] 15, 1939 (429–90). [Port.]

Detailed anatomical descriptions are given, both of the genus as a whole and of the individual species, and a key is provided for separating the woods of the latter. The species fall into four groups, of which the two first, with terminal or diffuse parenchyma, relatively numerous and small vessels, and uni- or bi-seriate medullary rays, are considered more primitive than the others, which have metatracheal or paratracheal parenchyma, fewer and larger vessels, and rays up to 5-seriate. In view of the homogeneity of the first group and its primitive characters, e.g. uniseriate rays, parenchyma little differentiated, transverse striation of fibres almost always lacking, the author believes that terminal parenchyma is the most primitive type within the genus. Diffuse parenchyma is considered to have arisen by dispersal, and metatracheal and paratracheal parenchyma by reapproximation of the longitudinal series. The commonest type within the genus is diffuse parenchyma, which always exists side by side with the more advanced types. The latter are never perfectly developed; thus in the metatracheal parenchyma the tangential series are almost always simple, interrupted, and irregularly disposed, while the paratracheal type is

never complete, the parenchyma scarcely covering ½ to ¾ of the circumference of the vessels.

31.2. *Physical Properties*

31.2 (71). **Nail-holding power of Eastern Canadian woods.** Timber Commission for Eastern Canada, 2 Cockspur Street, London, S.W. 1. *Wood Information Series* No. 44. 1939. p. 1.

A brief discussion of various types of nails and the nail-holding power of wood. The type of nail to be used should be selected with regard to the reaction of the wood in question as well as the purpose of construction. A table is included giving the nail-holding power, in pounds, of a number of eastern Canadian woods, both green and air-dry.

31.2 : 12.25.4 : 31.15. LANGLANDS, I. **Mechanical tests on small clear specimens of White Cypress Pine** [*Callitris glauca*]. *Repr.* from *Jnl. C.S.I.R.* 12, 1939 (16–17). Commonwealth of Australia, C.S.I.R., Div. of Forest Products, *Repr.* No. 55.

31.2 : 12.27.46. THOMAS, A. V. **Nyalas.** *Mal. For.* 8, 1939 (27–8).

Properties of the wood of *Parastemon urophyllum* A. DC.

31.2 : 33 (67). VORREITER, L. **Properties and uses of some East-African timbers.** *Tropenpflanzer* 42, 1939 (148–56). [G.]

Notes on Mkingu (botanical name uncertain), Mpapa (*Markhamia lanata* K. Schum.), Mgluka (*Boscia salicifolia*), Mfumbili (*Lonchocarpus bussei?*), Mgumbu (*Lannea cf. schimperi*), Mlakwenzi (*Pteleopsis myrtifolia*), Mtopetope (*Annona senegalensis*), Mukande (*Stereospermum dentatum?*), Mtonga (*Strychnos sp.*), Mlama (*Combretum splendens* Engl. and Diels), Mukatakwa (*Brackenridgea zanguebarica*), Mtundarikungulu or Mtundankungulu (*Alophylus sp.*), Mlwati (*Dombeya mupangae* K. Schum.), Muninga (*Pterocarpus bussei* Harms), and Msegese (*Bauhinia reticulata*).

31.2 : 98.3 (67.5). VAN MULDERS. **The timbers of the Belgian Congo.** *Rev. int. prod. col.* 14, 1939 (81–9). [F.f.]

A brief review of the mechanical properties of Limba (*Terminalia superba*), Kambala (*Chlorophora excelsa*), Ditshipi (*Macrolobium dewevrei*), Mukulungu (*Autranella congolensis*), Tshimaye (*Entandrophragma*), Lifaki (*Entandrophragma congoense*), Bosasa (*Guarea?*), Wenge (*Millettia laurentii*), Tshibudimbu (*Pachylobus pubescens*), Lusamba, Corail (*Pterocarpus soyauxii*), Ebène (*Diospyros*), and Fuma (*Ceiba pentandra?*). During the period 1922–37 exports of these species increased from 544 to 80,620 metric tons. In recent years trade has suffered through currency and import restrictions in Europe.

31.2 : 33.36 : 31.15 : 12.28.46 (91). THOMAS, A. V. **The timber of Yemane** [*Gmelina arborea*] **grown in Malaya.** *Mal. For.* 8, 1939 (84–5).

The results of a number of mechanical tests and observations on seasoning and impregnating treatment of the species *Gmelina arborea*. The material used was obtained from thinnings of plantations at Kepong.

31.22.1 : 07.7. THOMAS, A. J. **The 'Blinker' electrical moisture meter: recent modifications.** *Repr.* from *Jnl. C.S.I.R.* 12, 1939 (13–16). Commonwealth of Australia, C.S.I.R., Div. of Forest Products, *Repr.* No. 54.

The 'Blinker' electrical moisture meter for timber has been modified in the following ways. The 180-volt special battery has been replaced by a vibrator unit and two 1½-volt torch cells, parabolic mirrors have been included to make the glow of the lamps more easily seen, the cost of manufacture has been reduced by eliminating several individually made condensers and incorporating resistors, the size and weight have been reduced and a more convenient carrying case has been built. *Author's summary.*

31.22.2. GREENHILL, W. L. **Some recent investigations of the shrinkage of wood.** Lecture delivered at the Fourth International Conference on Timber Utilization. *Int. Rev. Timber Util.* No. 2/3. 1939 (52–3). Conf. ppr.

31.22.2 : 31.23. TRENDELENBURG, R. **On moisture at fibre saturation point, shrinkage, and specific gravity based on volume when green in some important timbers.** *Holz* 2, 1939 (12–17). [G.g.]

A comprehensive survey of recent research on variations in the degree of shrinkage and swelling of different species, with special reference to the more important German timbers. A detailed bibliography is appended to the paper.

31.27 : 31.13. JACCARD, P. **Resin canals and the mechanical properties of wood.** *Schweiz. Zeitschr. Forstw.* 90, 1939 (122–6). [G.]

In the samples of Larch wood examined, resin canals formed scarcely 0·1 per cent. of the total volume of the wood and had practically no influence on its mechanical properties. The canals were more numerous per sq. cm. in the central annual rings than towards the periphery, indicating that, as a rule, the number of resin canals present depends more or less on the growth rate of the cambium. A supplementary study of various softwoods and hardwoods showed a relation between the per cent. of cross-section area occupied by fibre walls and the density of the timbers and resistance to compression.

31.27 : 31.15 : 12.25.52 : (71). ROCHESTER, G. H. **The strength of Eastern Canadian Spruce timbers in sizes shipped to the United Kingdom.** *Forest Service Circular* 54. Government Printer, Ottawa. 1938. pp. 6.

The data presented are based on tests of 1,215 Eastern Canadian Spruce timbers of various sizes representative of all the principal producing areas of Quebec, New Brunswick, and Nova Scotia exporting timbers to the United Kingdom. The methods of testing used were similar to those employed by the Forest Products Research Laboratory, Princes Risborough, England. The tests indicated that the smaller-sized timbers [2×4 in. and 2×6 in.] have somewhat lower values for equivalent fibre stress at maximum load, due to the mill practice of cutting these sizes from small logs. The modulus of elasticity values were approximately the same for the 'full span' and 'centre third span' deflection methods. *From Author's summary.*

31.4. *Lasting Qualities. Durability. Decomposition*

31.42.1. KALLENBACH, F. **Noteworthy dry-rot damage.** *Z. Pilzk.* N.S. 17, 1938 (87–90).

Paxillus acheruntius (*P. panuoides*) is reported as having caused considerable damage in a new house in Germany for which insufficiently dried timber had been used. It is suspected that infection was introduced in planks from which the bark had not been removed. [*From Rev. Appl. Mycol.* 18, 1939: 426.]

31.42.1 : 31.22.1 : 31.23. GARREN, K. H. **Studies on *Polyporus abietinus*: III.** The influence of certain factors on the rate of decay of Loblolly Pine sapwood. *Jnl. For.* 37, 1939 (319–23).

Based on statistical analysis of laboratory studies it is determined that both the specific gravity and moisture content of the sapwood of Loblolly Pine (*Pinus taeda* L.) are significant factors in resistance to the decay produced by *Polyporus abietinus* (Dicks.). Resistance to decay is increased with increase in specific gravity and moisture content.

31.42.1 : 33.36.1. **Sap stain: its control.** *Timberman* 40, 1939 (24–6).

A brief discussion on the cause of sap stain and a description of equipment that is used in treating lumber to prevent infection. Certain mercury chloride compounds and combinations of sodium tetrachlorphenoxide have been found the most effective basic elements for dipping solutions.

31.43.2 : 47 (91.4). MESA, A. DE. **Molave [*Vitex parviflora* Juss.] and its carpenter moth enemy [*Xyleutes ceramicus* Walk.].** *Philip. Jnl. For.* 2, 1939 (45–53).

Molave [*Vitex parviflora* Juss.] is indigenous to the Philippines. It has a strong and durable wood which is resistant to fungus and termite attack, and is in much demand for construction, posts, railroad ties, &c. Pure stands of Molave are found to be infested by insects, the most serious of which is the Carpenter Moth (*Xyleutes* [*Duomitus*] *ceramicus* Walk.). A description is given of the insect, type of damage, its distribution and natural enemies. Some consideration is given to prevention and control.

31.7. *Specially Valuable Properties. Quality Timbers*

31.75 : 31.8 : 22.81 : 12.25.53. RAPRAEGER, E. F. **Development of branches and knots in Western White Pine.** *Jnl. For.* 37, 1939 (239–45).

A study of the size, type, and position of knots as determined by the position, longevity, and vitality of the branches, and also the relation of wood knottiness to wood strength and quality. It was determined that (*a*) for the two trees studied it required 72 and 93 years after the branches died until clear wood was produced, (*b*) branch size tends to increase higher up the

tree, where the branches are longer-lived, and (*c*) branch scars 30 to 60 ft. above ground appear to heal over more quickly than those of the same size 0–30 ft. above ground.

32. HARVESTING OF WOOD. LOGGING

32.1 (73). CURTIS, J. D. **A method of marking trees.** *Jnl. For.* 37, 1939 (246–9).

An experiment in the use of nails made of bamboo culm and numbered with a steel die, or painted, for identification. The most satisfactory nail tested was approximately ¼ in. in diameter, circular or elliptical in cross-section, and with a wedge-shaped point. The advantages and disadvantages of this type of nail are listed.

32.2 (91). MARSHALL, J. C. K. **Hardwood extraction by tramway.** *Mal. For.* 8, 1939 (21–3).

As used for extracting Chengal in Pahang.

32.23 : 23.26 (47). JEMTZEFF, W. **Technique in Russian forestry.** *Zeitschr. f. Weltf.* 6, 1939 (343–76). [G.g.e.]

Trends in the mechanization of Russian forestry are discussed and the more important mechanical appliances employed in the U.S.S.R. are reviewed with the aid of diagrams. Among these appliances are machines and tools used for the cleaning of clear-cut areas (stump-lifting, &c.), for soil cultivation, planting, the lifting of seedlings, the felling of trees, and the extraction of timber. A detailed explanation is given for some types of machinery used in lifting seedlings. So-called 'forest combines' are described. These are very large machines which have the combined functions of felling trees, lopping branches, logging to lengths varying between 3·5 and 8 metres, sorting logs into two size groups based on diameter, and stacking logs and branches into separate heaps.

32.23 : 33.11. STENTZEL, E. **Fresh results of an investigation on saws.** *Forstarchiv* 15, 1939 (1–24). [G.]

An attempt is made to determine the ideal form of teeth for different types of hand saws. Filing and sharpening are discussed, and it is pointed out that the proper care of saws is more important and economical than an ideal form of teeth.

33. CONVERSION. PRESERVATION. FASHIONING OF WOOD

33.11. Tools. Implements. Machines

33.11. SCHEFFTER, H. **Review of developments in the construction of portable motor saws.** *Holz* 2, 1939 (49–54). [G.]

Portable motor saws effect a considerable economy of labour. The more recent and important types of these saws are described with details of their design and an explanation of the type of drive employed. The objectives in view for future development are to reduce the weight of the saws, to simplify their manipulation, and to study the form of the teeth and the width of cut with a view to further improvement, while keeping the cost of the machines as low as possible.

33.11 (43). VOLLMER, H. **The importance of correct setting and sharpening of saws for efficiency in the timber industry.** *Holz* 2, 1939 (138–45). [G.g.]

New German types of machines for the sharpening and setting of milling saws explained and discussed with the aid of diagrams.

33.15. Wooden plates. Veneers

33.15. ALEXANDER, J. B. **Laboratory notes on glue and gluing.** *Lumberman* (*Br. Col.*) 23, 1939 (20–1 : 26–7).

A number of glues that are used in woodworking plants are described with reference to ingredients, preparation, characteristics, and methods of application. Notes are given on some methods for testing glue joints and on certain defects that may appear in glue joints and plywood due to poor material or bad construction.

33.15. ERNEST, E. C. M., and PETTIFOR, C. B. **Adhesion in plywood: the effect of warm moist conditions.** *Wood* 4, 1939 (65–6).

Tests made at Princes Risborough with several types of adhesive commonly used in plywood manufacture.

33.15. JESSUP, D. A., WEISSBERG, S. G., and WEBER, C. G. **Accelerated ageing of fibre building boards.** *U.S. Dept. of Commerce, National Bureau of Standards, Building*

Materials and Structures Report BMS 4. Washington. 1938. pp. 29. F.P.R.L.

Fibre building boards are being tested to determine whether they have satisfactory permanence to justify their wide use in low-cost house construction. Accelerated ageing is being used because this information is urgently needed, inasmuch as it would take years to obtain the effects of normal ageing. The ageing treatments include cycles of wetting, drying, freezing, and heating in dry air, and the stability is judged by changes in physical and chemical properties. The properties most affected by ageing are water absorption, nail-holding power, flexual strength, and permeability to air. Results thus far obtained are favourable. After being subjected to ageing cycles for a total of 300 hours, only two of the boards tested showed serious loss of strength and other desirable properties, despite the drastic routine of the treatments. *Author's summary.*

33.15. SAUER, E. **A process for testing high-quality glues.** *Holztechnik* 19, 1939 (167–72). [G.g.] F.P.R.L.

Consists in determining the tensile strength of glued joints made with Beech test pieces of standard dimensions and known moisture content. Joints were made on the ends of the test pieces, since in joints parallel to the wood fibres the glue is stronger than the wood. The test pieces employed measured 10×10×70 mm., giving a joint area of 1 sq. cm. Moisture content was controlled by placing the test pieces in closed vessels over saturated solutions of salts of known vapour pressure and weighing at intervals until no further change occurred. The most suitable moisture content for testing was 55 per cent. and was obtained by storage over a saturated solution of calcium nitrate.

33.15 : 07.7 (43). MORÄTH, E. **New features in veneer and plywood machines.** *Holz* 2, 1939 (70–8). [G.g.]

In attempting to economize in labour, power, and raw material tests have been made in (*a*) heating of the steaming plant with hot water in place of steam, (*b*) improvement of peeling and cutting machines with particular attention to refinements in drying installations, including self-recording measuring instruments and automatic regulators, (*c*) improvements in the machinery for the manufacture of veneer, with a view to more thorough utilization. Presses have changed very little, but there has been a marked improvement in the machinery for the finishing of plywood and for the manufacture of boards used in cabinet-making.

33.15 : 31.15. FRIEDRICH, K. **The testing of fibre boards.** *Holz* 2, 1939 (131–5). [G.g.]

Summarized account of the main methods and instruments employed for the testing of fibre boards, with special reference to investigations that can be carried out under factory conditions.

33.15 : 31.27 : 31.15. RIECHERS, K. **On the use and testing of highly compressed wood.** *Holz* 2, 1939 (109–15). [G.g.]

With special reference to the use of Lignofol in the manufacture of propeller blades.

33.15 : 33.16 (43). KOLLMANN, F. **The manufacture of light wallboards from wood-wool.** *Holz* 2, 1939 (55–61). [G.g.]

The total sales of light wallboards, manufactured in Germany from wood-wool, have increased from 2·33 million sq. metres in 1932 to 23 million sq. metres in 1938. A review of the basic materials required—wood-wool, cement, magnesite mortar, and gypsum— is followed by a description of the more important processes of wallboard manufacture, ranging from Dr. Gaspary's method, adapted to the requirements of the small and medium-sized enterprise, to the highly developed *Heraklith-Verfahren* used in mass production.

33.3. *Chemical Treatment of Wood*

33.3 : 33.36.3 (71.1). JENKINS, J. H. **Chemicals in the seasoning of British Columbia timber.** *Lumberman* (Br. Col.) 23, 1939 (53).

Ten large flitches of Douglas Fir, Sitka Spruce, Western Red Cedar, and Western Larch were treated with common salt, either in solution in water or applied dry to the surface, before kiln-drying under controlled conditions. After seasoning, six of the flitches were free of defect and of good appearance, while single surface checks appeared on one face of each of the other four.

33.32. Cellulose. Paper manufacture

33.32. HÄGGLUND, E. **The utilization of waste liquors from cellulose manufacture.** *Holz* 2, 1939 (18–21). [G.g.]

A discussion of the utilization of the waste liquors of sulphite pulp manufacture for fuel, and for the production of sulphite spirit, sulphite yeast, tanstuffs and detergents, fertilizers, adhesives and agglutinants, and vanillin; also of recovering alkali from the black lyes of soda-pulp factories without burning the organic components of the lyes; and finally of the refinement of liquid resin obtained as a by-product of cellulose manufacture.

33.32 : 12.25.5 (44.38). GUINIER, P. **The utilization for paper-making of three American conifers planted in the east of France** [*Picea sitchensis, Abies grandis,* **and** *Pseudotsuga douglasii*]. *Bull. Com. For., Paris* 11, 1939 (748–61). [F.]

Satisfactory tests have been made of the pulping quality of the wood from 20 to 30 year-old-trees grown in the Amance Forest near Nancy.

33.32 : 23.3 (44). DUTILLOY, P. **The French paper pulp industry:** statement drawn up for the Conseil National Économique. *Bull. Com. For. Paris* 11, 1939 (712–47). [F.]

A general survey of the subject with special reference to current problems. Stress is laid on the need of and possible profit from private and communal planting of Spruce and Fir to supply the requirements of the French paper pulp industry. Recent French statistics reveal the existence of about 5·4 million ha. of waste land, much of which could be afforested. It is suggested that, with the aid of government subsidies, 500,000 to 600,000 ha. should be planted at a rate of 15,000 to 20,000 ha. per annum. The funds for this work would be obtained from additional cuttings in the existing forests, and these cuttings would constitute an immediate source of supply for the paper pulp industry.

33.36. Preservation of wood

33.36. LUTZ, L. **Uncertainties in the American 'agar' method of determining the toxicity of antiseptics used to preserve timber.** *Rev. int. du bois* 6, 1939 (11–13). [F.]

Criticism and suggestions for modification of the method.

33.36. MOLL, F. **Protection and preservation of timber structures destined for export to the tropics.**—Lecture and discussion at the Fourth International Conference on Timber Utilization. *Int. Rev. Timber Util.* No. 2/3. 1939 (48–52). Conf. ppr.

33.36. RICHARDSON, N. A., and LARNER, E. E. **Leaching tests on aqueous wood preservative mixtures containing alkali chromates.** *J. Soc. Chem. Ind., Lond.* 58, 1939 (66–9).

Tests of mercuric chloride, zinc chloride, copper sulphate, sodium arsenate, and sodium fluoride, each in mixture with potassium dichromate. With certain salts, notably mercuric chloride, over 95 per cent. fixation in the wood can be attained by the admixture of potassium dichromate, though it is not yet possible to deduce the chemical changes taking place between the wood and the preservative mixtures. [Condensed from *Rev. Appl. Mycol.* 18, 1939: 426.]

33.36. SCHULZE, B. **The comprehensive testing of wood preservatives against wood-destroying fungi and animals.** *Holz* 2, 1939 (99–109). [G.g.]

A review of the methods and instruments used in the biological, chemical, physical, and mechanical testing of preservatives.

33.36. WRIGHT, G. W. **A colour method of detecting the depth of penetration of sodium chloride into timber which has been immersed in a solution of the salt.** *Jnl. C.S.I.R. Australia* 12, 1939 (83–4). F.P.R.L.

A freshly cut section of timber, which has been immersed in a solution of sodium chloride, is sprayed with a silver nitrate solution and exposed to sunlight. A strong colour contrast is obtained between the silver chloride precipitate in the area affected by the diffusion of sodium chloride and the darkened deposition of silver in the area not affected. *From Author's summary.*

33.36.1. THOMAS, A. V. **The prevention of 'blue stain' in Jelutong timber.** *Mal. For.* 8, 1939 (18–21).

It is shown that 3-in. planks can be air-dried without serious degrade and that solutions of Lignasan and sodium silicofluoride may be slightly more effective than borax in preventing stain. It also appears possible that borax should not be used in treating piling stickers.

33.36 : 31.42.1 : 12.21. RABANUS, A. **On the acid production of fungi and its influence on the action of wood preservatives.** *Mitt. dtsch. Forstver.* 23, 1939 (77–89).

Certain common wood-destroying fungi produced in culture sufficient oxalic acid to convert the copper carbonate formed from copper sulphate on treated telegraph poles into insoluble, and therefore innocuous copper oxalate. The alleged inadequacy of copper sulphate treatment of timber on calcareous soils is attributed, not to any deleterious influence of lime *per se*, but solely to this faculty of certain fungi for producing oxalic acid. [Condensed from *Rev. Appl. Mycol.* 18, 1939: 426.]

33.36.1 : 31.43.2 : 13.21.85.65.42. CUMMINS, J. E. **The preservation of timber against the attacks of the Powder Post Borer [*Lyctus brunneus* Stephens] by impregnation with boric acid.** *Repr.* from *Jnl. C.S.I.R.* 12, 1939 (30–49). Commonwealth of Australia, C.S.I.R., Div. of Forest Products, *Repr.* No. 56.

Laboratory and commercial tests indicate that wood should be treated after it has been cut into veneer and before it dries. Green veneer can be treated easily and satisfactorily at a low cost. The veneer is immersed in a 1·25 per cent. solution of boric acid at a temperature of from 200° to 213° F., the period of immersion varying with the species. The veneer should not be thicker than $\frac{3}{16}$ in. Boric acid should be added at frequent intervals to maintain the strength of the solution. A provisional patent specification for the treatment outlined has been lodged and accepted.

33.36.1 : 33.31. BRYAN, J. **A new preservative.** *Repr.* from *Wood* 4, 1939 (161–2).

A new wood preservative mixture has been evolved in which mercuric chloride is the toxic constituent. The disadvantages connected with the use of mercuric chloride in the past—its corrosive effect on metals and the tendency to leach when exposed to water or external conditions—have been largely overcome without adversely affecting its toxicity.

33.36.1 : 33.4 (43.7). STAUCH, C. **The use of timbers deeply impregnated with mercuric chloride for lining State mines in Czecho-Slovakia.** *Rev. int. du bois* 6, 1939 (36–40). [F.]

The method is based on a technique evolved after long experiment by Mr. Charles Bubla and has been used in Czecho-Slovakia on a large scale since 1932. So far not a single piece of timber thus preserved has been attacked by rot, and it is estimated that the process prolongs the life of mining timber at least four times. It is now being extended to the impregnation of poles for electrical services, particularly in towns.

33.36.2. **Progress and refinements in the process of fire-proofing wood by autoclave.** *Rev. int. du bois* 6, 1939 (51–6). [F.f.]

Brief survey of recent achievements in the fire-proofing industry.

33.36.2 (494). **How to guard against fire danger in wooden buildings.** *Rev. int. du bois* 6, 1939 (41–5). [F.]

Experiments in Switzerland.

33.36.2 : 33.15 (43). FRIEDRICH, K. **Fire-proofed fibre boards.** *Holz* 2, 1939 (62–5). [G.g.]

The types and properties of fibre boards are discussed. They burn in much the same way as wood, and the same substance and methods can be used in fire-proofing these related materials. It is pointed out that in fire-proofing fibre boards it is simpler to impregnate the finished board than during the manufacturing process. It is recommended that the German regulations for the testing of fire-proofed fibre boards should be modified on lines similar to the British standard regulations.

33.36.2 : 33.4. CAMPREDON, J. **The protection of wood against fire.** *Rev. int. du bois* 6, 1939 (1–10). [F.f.]

Impregnation with substances resistant to fire and precautions to be observed in the use of timber for structural purposes are discussed. It is concluded that the use of timber for such purposes need not involve risks any greater than the use of stone or metal.

33.36.3 : 12.27.39. THOMAS, A. V. **Seasoning experiment with Meranti Bakau [*Shorea rugosa* Heim.].** *Mal. For.* 8, 1939 (24–6).

Boards sawn from logs of two trees were placed in one stack, protected from sun and rain, and the effect of seasoning was determined by observations and notes on sample boards. The moisture content of freshly sawn timber ranges from 60 to 75 per cent. Planks $1\frac{1}{2}$ in. thick take about 6 months to become air-dried. The average shrinkage of all planks in this experiment was 4 per cent. It appears that the best piling sticker size is 1 in. to $1\frac{3}{4}$ in. in thick-

ness. Cupping and warping are the principal defects, and may be controlled by placing stickers not more than 30 in. apart and weighting the stack with heavy timbers.

33.36.3 : 32.3 : 12.26.22. GELINSKY, H. **Is it possible to preserve the white colour of Beech wood after felling?** *Holz* 2, 1939 (129–31). [G.g.]

Apart from protective coatings the only means of diminishing discoloration is to cut up the felled Beech timber as soon as possible and into as small sizes as possible, stacking it so that ample aeration is possible. Even with these precautions, air seasoning will not give completely white timber unless the thickness of the timber is less than 10 cm. in at least one direction. Discoloration is greatly reduced by kiln-drying.

33.36.3 : 33.36.5. VOORHIES, G. **Steam demand in drying Douglas Fir lumber.** *Timberman* 40, 1939 (35 and 64).

This study, illustrated by graphs, shows that the steam-demand curve follows very closely the moisture-content curve. A water jet in the steam-spray line will reduce the steam consumption only during the intermittent and final steaming periods. Probably the greatest saving in steam can be effected by the correct functioning of the automatic vent controls so that the moisture from the lumber will maintain the relative humidity in the kiln and at the same time allow no excessive heat loss through the vents.

The steam used for the steaming and normal drying periods in the operation studied is as follows:

Stocks	*Initial Steaming per cent.*	*Normal Drying per cent.*	*Intermittent Steaming per cent.*	*Final Steaming per cent.*
4/4	17·5	73·9	0	8·6
5/4	14·7	78·7	0	6·6
6/4	11·0	81·02	3·68	4·3
8/4	12·6	74·95	5·45	7·0

From Author's Summary.

33.36.3 : 33.6. KAPUR, S. N. **Kiln-drying of light hardwoods for packing cases.** *Ind. For.* 65, 1939 (210–14).

Wood to be used for packing cases should be light, reasonably dry, and free from insects and fungi, and therefore rapid seasoning is indicated. Kiln drying has many advantages over air seasoning in this regard. Tests have shown the time required to kiln-dry absolutely green wood (100 per cent. to 150 per cent. moisture content) to a 10 per cent. moisture content as follows:

Tula (*Tetrameles nudiflora*), $\frac{1}{2}$ in. to $\frac{5}{8}$ in. thick—30 to 36 hours.

Tula (*Tetrameles nudiflora*), $\frac{3}{4}$ in. to $\frac{7}{8}$ in. thick—60 hours.

Semul (*Bombax malabaricum*), $\frac{1}{2}$ in. thick—48 to 52 hours.

The cost of kiln drying for an output of 120 tons of $\frac{1}{2}$-in. shooks per month comes to less than 1 anna per cubic foot.

33.36.5 : 31.27 : 31.22 : 33.12 (43). KOLLMANN, F. **Changes in the properties of wood subjected to steaming.** *Holz* 2, 1939 (1–11). [G.g.]

Wood that had been steamed under various conditions was examined for moisture absorption, swelling, distribution of temperature, and changes in chemical composition and physical properties such as resistance to compression and impact, and modulus of elasticity, with special reference to requirements for subsequent bending. The results of the investigation are discussed and embodied in numerous tables and graphs.

33.38. Charcoal manufacture. Charcoal. Use of wood in power-gas generators

33.38 (44). GUILLAUME, P. **Utilization on the railways of discarded creosoted sleepers, &c., as a source of producer gas.** *Rev. int. du bois* 6, 1939 (79–95). [F.f.]

The carbonization of old creosoted hardwood timber furnishes excellent charcoal with a calorific value of about 8,000 calories and a carbon content of over 90 per cent. This type of charcoal, known as *Geka*, is well suited for the generation of producer-gas for locomotives, rail cars, transportable cranes, &c., as has been proved by the experience of the French railway companies. So far, it has been employed only on a small scale. There are, however, about 400,000 metric tons of railway sleepers and other creosoted hardwood timber available from the annual replacements of the French Railways: careful carbonization of this material should furnish about 100,000 tons of *Geka*, which in turn should generate as much power as 1,000,000 hectolitres of petrol at about a quarter

of the cost. The considerable economy of petrol thus effected would, moreover, be of great importance from the standpoint of National Defence.

33.38(485). LOTHIGIUS, W. **The rationalization of charcoal manufacture.** *Skogsägaren* 15, 1939 (14–19). [Sw.]

The bulk of Swedish charcoal has hitherto been produced by the crude method of pile burning. Kilns have been used only where large permanent supplies of wood were available, i.e. near sawmills and floating channels. Both forms of the industry have been seriously affected by the low prices obtained for their products. To ensure supplies of charcoal for ironworks, to encourage the use of wood gas by facilitating the distribution and improving the quality of charcoal, and to find a use for large quantities of timber of small dimensions, the author recommends the adoption of small stationary kilns situated on roadsides and as near as possible to the forests supplying timber. Each kiln should have a permanent shed where the charcoal could be stored without deterioration. Compared with pile burning, the chief advantages of small stationary kilns are the lower production costs, more uniform yield, and better quality of charcoal. Further points are that less skill is needed to operate kilns, that burning can be done at any convenient time of year, and that when time is short even green and unbarked wood can be dealt with.

33.39. Saccharification. Manufacture of alcohol

33.39. ENDERS, C., and KÄRNBACH, K. **The composition of the fusel oils obtained in the fermentation of wood-sugar liquors by the Scholler process.** *Holz* 2, 1939 (135–8). [G.g.]

These fusel oils contain 10 per cent. neutral high-boiling substances belonging to the terpene group, which impede yeast increase and should therefore be eliminated from wood-sugar liquors before fermentation. They also contain small quantities of pyromucic acid, guaiacol, and cyclopentane.

33.4. *Timber in Structures above and below ground*

33.4 : 31.47. HECKER, H. W., and BRUNN, W. **Comparative experiments on the properties of Pine and Spruce pit-props, with special reference to the behaviour of 'stem-dry' [*stammtrocken*] timbers.** *Holz* 2, 1939 (24–8). [G.g.]

Strength values of Pine pit-props, although somewhat inferior to those of Spruce, were found quite adequate for safety. 'Stem-dry' pit-props, provided they were only slightly infested with fungi and insects, were but little inferior to healthy ones, and, on the whole, showed quite satisfactory mechanical properties.

33.8. *Other Fashioning of Wood*

33.8 : 12.28.55. DESCH, H. E. **Jelutong timber for battery separators.** *Mal. For.* 8, 1939. (23–4).

Tests of chemically treated Jelutong proved its suitability for this purpose.

34. MINOR FOREST PRODUCTS AND THEIR UTILIZATION

34 (42). JAMES, N. D. G. **The disposal of minor woodland produce.** *Jnl. Land Agents' Soc.* 38, 1939 (196–9).

In Great Britain.

34.23 (71.1). JENKINS, J. H. **Wood-waste utilization in British Columbia.** Dominion Forest Service, Forest Products Laboratories of Canada, Vancouver Laboratory. 1939. pp. 8.

A discussion of the present and possible future methods of utilizing sawmill waste in British Columbia. At present fuel in various forms and pulp are the chief outlets for this waste.

34.25. **The world's cinchona bark industry.**—I. *Bull. Imp. Inst.* 37, 1939 (18–31).

34.26 (54.2). ROBERTSON, F. C. F. **Resin-tapping in Kumaon.** Part I.—A survey of recent developments in field practice, with particular reference to the West Almora Division, U.P. *Ind. For.* 65, 1939 (3–17). Part II—Notes on research and some recent field studies bearing on future resin supply. *Ind. For.* 65, 1939 (88–104), (137–45).

Developments and improvements in setting up and tapping procedure, involving the introduction of tools and gauges of superior design and quality, are considered. Recent field studies

in light tapping confirm fears of premature exhaustion, indicating that tapping life expectancy of the smallest tapped trees must be shortened from 70 to under 50 years and for typical coupes to less than 60 years. The implications for future resin management are discussed, with suggestions for modifying both tapping method and silviculture. *From author's summary.*

34.26 : 12.25.53 (91.4). AGUILAR, L. **Tapping Benguet Pine [*Pinus insularis* Endl.] in the Mountain Province.** *Philip. Jnl. For.* 2, 1939 (65–78).

A study of the yield of oleo-resin from Benguet Pine (*Pinus insularis* Endl.). The following facts were observed: (1) With one chipping, the yield on the first day ranges from 91·9 per cent. to 94·34 per cent. of the total yield in a week, and the flow stopped on the 5th or 6th day. (2) Of the 3, 5, and 7-day chipping intervals, the yield per cup for every chipping is greatest for the 5-day chipping interval though the difference is not significant. (3) The yield rises with increase in diameter up to and including 60 cm. (4) There is no significant relation between amount of resin obtained and side of tree tapped. (5) Of the three types of Benguet Pines tapped, the type with a deep-furrowed bark yielded the most resin, followed by the intermediate type, the lowest yield being given by the smooth-scaly type. (6) There is a very low correlation of yield of resin with temperature, rainfall, and humidity. (7) The average yield of resin of Benguet Pine per cup for every chipping is about 50 grammes, and it can be tapped throughout the year. At this rate the annual yield per tree with one face is 3·6 kilograms. *From author's summary.*

34.31.3 : 45.1 : 91.11.4 (77). CAHALANE, V. H. **Integration of wildlife management with forestry in the Central States.** *Jnl. For.* 37, 1939 (162–7). Conf. ppr.

34.39. MURTY, N. N. **Contribution to the study of the bleaching of lac:** Pt. II. Factors which influence the keeping quality of bleached lac. *Repr.* from *Ind. Engng. Chem.* 31, 1939 (235–9). Indian Lac Research Institute, *Bull.* No. 32.

34.39. THAKUR, A. K., BHOWMIK, T., and SEN, H. K. **Improved method of seedlac manufacture by the country process.** *Technical Note* No. 4. Indian Lac Research Institute, Namkum, Ranchi, Bihar, India. 1939. pp. 3.

35. SALE AND DISPOSAL OF FOREST PRODUCTS. TIMBER TRADE

35 : 98.1 (73). HALLAUER. **Pitfalls in interpreting lumber consumption trends.** *Jnl. For.* 37, 1939 (47–9).

The actual *per capita* consumption is about the same as it was 30 years ago.

37. FOREST TRANSPORT

37.1 : 32.2. PRATT, R. W. **Load distribution on log trucks.** *Timberman* 40, 1939 (16–22).

An analysis of the factors that determine the proper distribution of log loads in truck hauling.

4. PROTECTION

42. INJURIES FROM INORGANIC AGENCIES

42.31 : 42.34 : 11.63.11 (54.5). WARREN, W. D. M. **Flood and erosion control:** an account of experiments conducted by the Forest and Irrigation Research Departments, Punjab. Superintendent, Govt. Printing, Bihar, Patna. 1939. pp. 17.

Data obtained in the first year of measurement, from experimental run-off trays containing different percentages of vegetation cover, and in two cases vegetation that was clipped to represent the effect of grazing indicated that the amount of run-off after a slight rainfall depends upon the initial moisture content of the soil, and that the percentage run-off depends more on the intensity of rainfall than on the total quantity. The amount of erosion is reduced perceptibly as the vegetation becomes densely established and heavy erosion continues where the vegetation is continually clipped back. Measurement figures for the second year show that for a storm of heavy volume and intensity the run-off from the two trays containing vegetation that had been clipped back was 96 per cent. and 92 per cent., with a high silt collection, whereas the trays having a complete vegetation of grass had a run-off of 26 per cent. and 31 per cent. The trays containing a complete

vegetation cover of both grass and annuals show an even better absorption capacity.

From larger-scale control measures valuable results are being obtained by closure of areas to grazing, gully plugging, and planting and sowing areas with grass, shrubs, and trees: species that have been found most valuable as soil binders are the Agave or Aloe, *Opuntia*, *Ipomoea carnea*, and *Bucharis sanathroides*.

43. FOREST FIRES

43.1. RYDBECK, A. **Extinguishing forest fires with foam.** *Skogen* 26, 1939 (169–72). [Sw.]

A portable foam-spraying outfit recently put on the market by a Swedish firm is likely to prove useful in controlling surface fires. The outfit weighs 29 kg. when fully loaded, and each loading produces 100 l. of foam. Preliminary trials are promising: two ribbons of foam 30–40 cm. wide and a metre or two apart have so far been completely effective in checking the advancing front of surface fires. It is estimated that a crew of 10–15 men with 5 sprayers could lay down a ribbon of foam 60–100 m. long within a few minutes of their arrival upon the scene of a fire. A marked advantage is that comparatively little water is used in making the foam. The author urges the desirability of further trials under varied conditions.

43.1 (71). **Forest fire-fighting pumps.**—Contribution by Forestry Branch, Department of Land and Forests, Ontario. *Fire Control Notes* 3, 1939 (11–12).

43.1 (71). HEADLEY, R. **Trends toward mechanization of forest fire control.** *For. Chron.* 15, 1939 (29–33). Conf. ppr.

43.1 (73). HANSON, P. D. **Tractor use in fire suppression.** *Fire Control Notes* 3, 1939 (22–4).

Economic and other advantages of the use of tractors in the U.S.A.

43.1 (73). LORENZEN, C. **Tests on the use of compressed air in fire suppression.**—*Fire Control Notes* 3, 1939 (8–10).

A nozzle with a mixing chamber for air and water was experimented with in California, with negative results.

43.1 : 07.1. BROWN, L. P. **Training overhead for suppression work.** *Fire Control Notes* 3, 1939 (1–8).

43.11 (79.4). BRUCE, H. D. **Sterilizing soil with chemicals for firebreak maintenance.** *Fire Control Notes* 3, 1939 (17–21).

Satisfactory results are recorded from preliminary experiments, in California, with arsenic trioxide and sodium chlorate.

43.12 (73). JONES, H. R. **Recent developments in lookout towers.** *Fire Control Notes* 3, 1939 (1–3).

The present status of timber and steel towers in the U.S.A.

43.13 (73). SIMSON, A. G. **Recent additions to Forest Service radio equipment.** *Fire Control Notes* 3, 1939 (25–7).

Two new sets used in the U.S.A.

44. PROTECTION AGAINST DAMAGE BY HARMFUL PLANTS

44.1 : 23.24.8 : 24.36 (54.5). DEOGUN, P. N. **Succession in plantations of light-crowned species.** *Ind. For.* 45, 1939 (201–4).

The invasion of potential forest areas and plantations by Dab grass (*Eragrostis cynosuroides*) and *Imperata*, particularly in openings and under light-crowned species such as Frash (*Tamarix articulata*), results in the blocking of irrigation trenches and makes further planting very difficult. Investigations have shown that the two species Mulberry (*Morus* sp.) and Bakain (*Melia azedarach*), when planted on such areas, are effective in eliminating these weeds.

44.3 : 12.21 : 47. JØRSTAD, I., and JUUL, J. G. Råtesopper på levende nåletraer. **[Rot fungi on living conifers.]** *Medd. Norske Skogsforsøksv.* No. 22 [Vol. 6, No. 3] (303–496). [Nor.e.]

An account is given of *Coniophora* sp. cf. *olivacea*, *Polyporus schweinizii*, *P. pinicola*, *P. pini*, *P. tomentosus* var. *circinatus*, and *Stereum sanguinolentum*, which are all known to cause decay of Norway Spruce and Scots Pine in Norway. The fungi and the rots caused by them are described and an extensive review is given of their nomenclature, occurrence, hosts, and economic importance. The descriptions of the types of rot produced are repeated in brief in the English summary.

44.3 : 12.25.52 (43). ROHMEDER, E. **Protective treatment of wounds on injured**

Spruce trees. *Forstw. Centralbl.* 61, 1939 (17–27). [G.g.]

Provisional results of a large-scale experiment by the Bavarian Forestry Research Institute. Of the protective coatings examined, de-acidified coal-tar and a patent coating prepared by the I.G. Farbenindustrie A.G. proved most satisfactory. Successful prevention of fungal infection depends on early application.

44.3 : 23.26.7. Ten Houten, J. G. Kiemplantenziekten van coniferen. [**Diseases of coniferous seedlings.**] Drukkerij J. van Boekhoven, Utrecht and Amsterdam. Doctorate thesis. 1939. pp. 128. [Du.e.]

Different types of damping-off are described and a list is given of the many fungi causing this disease in coniferous seedlings in the nurseries of Holland. Inoculation tests on Scots Pine and Austrian Pine indicated the most destructive of these parasites. The symptoms produced in the seedling hosts are described. The medium on which the fungi are grown, before being placed in the soil, has an influence on their virulence. Various soils were inoculated with a virulent strain of *Rhizoctonia solani* and sown with disinfected seed. Mortality of seedlings due to damping-off was less on Pine forest soil than on garden soil, heath soil, dune soil, or loess soil, and unsterilized Pine forest soil proved more satisfactory than autoclaved soil, probably because of the antagonistic action of *Trichoderma lignosum* on the parasitic fungi. Furthermore, the greater the acidity of the Pine forest soil the less damage resulted from the parasitism of *Rhizoctonia solani*. Further tests indicated that Austrian Pine seed should be sown in March and April to reduce the rate of damping-off as much as possible.

It was found that the seed-bed treatments most effective in controlling damping-off were (*a*) for Austrian Pine—cover the seed with heath sand and gravel, (*b*) for Douglas Fir—treat beds with 5 l. of 1 per cent. solution of sulphuric acid per square metre.

44.3 : 45.3 (43). Voelkel, H., and Klemm, M. Die wichtigsten Krankheiten und Schädigungen an Kulturpflanzen in Jahre 1938. [**The most important diseases and injuries of cultivated plants in 1938.**] Suppl. to *Nachrichtenbl. f. d. Pflanz.* 19, 1939. pp. 31.

German forest diseases and pests on pp. 30–1.

45. PROTECTION AGAINST DAMAGE BY ANIMALS

45.1 (43). Bromée, F. **Bark-scaling damage by stags and elks: preventive measures employed in Germany for Ash, Oak, and Spruce.** *Skogen* 26, 1939 (80–2). [Sw.]

Young Oak and Ash stems are painted with a tepid mixture prepared by stirring and heating 12 parts of coal tar, 1 part of soda, and 2 parts of ox blood. A single painting is effective over about 15 years, by which time the bark has usually become too hard and rough for the animals to gnaw. Stems of Norway Spruce, Silver Fir, and Douglas Fir are rendered distasteful by stimulating resin production. The bark is removed in patches to about half its thickness by means of a special 'bark plane'. This operation, which needs much care, is best performed immediately before or at the onset of sap flow; its effectiveness is probably limited to about 5 years. Both of these protective treatments are laborious and rather expensive; hence they are worth while with young stands of high quality only. Why the bark of young trees attract deer and elk is not yet known. If the substances sought by the animals could be discovered, damage to trees might be avoided by supplying them—possibly by incorporation in salt licks. Protection by this method would probably be much cheaper than the measures described above.

45.1 : 44.3 : 47. Schimitschek, E. **Researches on damage due to bark-scaling by deer and its consequences:** I. Research on scaled Spruce stands in the region of the north-west border of the Eastern Alps. *Centralbl. f. d. g. Forstw.* 65, 1939 (33–50: 65–82: 97–121). [G.]

A survey of the extent of damage due to scaling and subsequent infection of the scaled trees by *Polyporus annosus* in several plots under different conditions of habitat and silvicultural treatment. Stem analyses were made for estimating the loss in timber volume and in value. Losses were heaviest in untended stands which had never been thinned.

45.3 : 13.21.85.53.41 : 47. Escherich, K. L. **The tumour disease of Oak and its causes. —*Lachnus roboris* L.** *Forstw. Centralbl.* 61, 1939 (75–81). [G.]

Damage illustrated with detailed photographic material.

45·3 : 13.21.85.53.42. HOFMANN, C. **Research on *Dreyfusia* [*Chermes*] *nüsslini* C.B.** *Forstw. Centralbl.* 61, 1939 (161–76 : 211–21). [G.]

45·3 : 13.21.85.82. HOFMANN, C. **Modern control of major forest pests, with particular reference to *Lymantria monacha* L. and *Bupalus piniarius* L.** *Nachrichten über Schädlingsbekämpfung* 14, 1939 (1–43). [G.g.e.f.sp.]

The author reports satisfactory results from preliminary laboratory and field experiments with the new contact dusts '2152' and '2172' prepared by the I.G. Farbenindustrie A.G. These dusts are not poisonous to warm-blooded animals and bees.

45·3 : 13.21.85.91.1. McDANIEL, E. I. **Suggestions for the control of sawflies on conifers.** *Mich. Agric. Expt. Sta. Quart. Bull.* 21, 1939 (161–4).

45·3 : 22.8 (921). SCHNEIDER, F. **A comparison of primeval forest and 'monocultures' [pure cultivated stands] in relation to the risk of injury by phytophagous insects, based on observations on the east coast of Sumatra.** *Schweiz. Zeitschr. Forstw.* 90, 1939 (82–9). [G.]

Exemplified by population studies of *Oreta carnea* in plantations of *Uncaria gambir*.

45·3 : 44·3 : 12.21 : 13.21.85.68.4. FRANSEN, J. J. Iepenziekte, iepenspintkevers, en beider bestrijding. [**Elm disease, Elm bark beetles, and the control of both.**] H. Veenman & Zonen, Wageningen. 1939. pp. 118. [Du.e.]

This work is divided into five chapters dealing with (1) the transmission of the Elm disease, (2) the feeding period, (3) the generations of the Elm bark beetles, (4) the epidemology of the Elm bark beetles, and (5) the control of the Elm disease.

The Elm bark beetles, both *Scolytus scolytus*, and *S. multistriatus*, in feeding on healthy elm trees infect them with the Elm disease *Ceratostomella ulmi*, the spores of which are carried by the beetles. Each brood of beetles is newly infected with the fungus in the pupal cells. The mite *Pseudotarsonemoïdes innumerabilis* aids in the transport of the spores of the fungus. While control of the fungus appears to be hopeless, the one possibility of protecting healthy Elms from infection is to prevent the bark beetles from feeding on them. Many experiments were tried both to destroy the beetles in infected trees and to render trees unsuitable for the beetles. Trap trees of species particularly attractive to the beetles, as *Ulmus pumila* and *U. foliacea*, may be used in plantations. Barking the trees or immersing them for six months are definite remedies in treating wood-piles, though both methods affect the quality of the wood. Coal-tar and Carbolineum were found to be most effective as repellants to the beetles. The population of the Elm bark beetle is continually drained by parasites and predators, and some degree of biological control may be attained by the protection of birds that feed on these insects and by rearing and distributing the parasite, *Coeloides scolyticida*.

45·3 : 47. ECKSTEIN, K. **Damage to shoots by the Pine beetle *Myelophilus piniperda* L.** *Forstw. Centralbl.* 61, 1939 (81–92). [G.]

A description of the types of damage.

5. INCREMENT. YIELD

51. INSTRUMENTS. MEASURES AND WEIGHTS

51. **Calculating timber volume:** A Swedish engineer's invention. *T. T. Jnl.* 148, 1939 (5).

A calculating machine which in a few seconds will give the exact volume of a tree of any size, solving an equation after five of its variables have been given exact values.

51 : 52.2. ROY, N. C. **A ready reference chart for Abney's heights.** *Ind. For.* 65, 1939 (72–3).

This chart enables quick determination of heights from the angular measurements made with Abney's Level or similar instruments, without mathematical calculations.

52. MEASUREMENT OF TIMBER VOLUME

52.43.3 : 12.25.53 (485). MAASS, A. **The stem form of Pine in Sweden as determined by diameter at 2·3 m. above ground level.** *Sven. Sk. Tids.* 37, 1939 (120–40). [Sw.g.]

The author constructed form-class volume

tables with the form quotient: diameter at 2·3 m. above soil level/diameter at breast height (1·3 m. above soil level). These tables were tested in several estimates in different parts of Sweden, and the error was below ±3 per cent. as compared with actual measurements.

52.43.32 : 12.27.48. GONGGRIJP, L. **Preliminary volume tables for *Acacia decurrens* var. *mollis* Benth.** *Repr.* from *Tectona* 32, 1939 (191–218). *Korte Mededeelingen van het Boschbouwproefstation* No. 68. [Du.e.]

From the tables an estimate may be made of the stem volume, including bark, given the total stem-height, or height expressed in per cent. of the total height, or the diameter over bark at the small end up to 7 cm. For trees up to 7 cm. in diameter, outside bark, the yield of wet bark in kg. can also be determined. The tables are based on the measurement of 468 trees, 3 to 8 years old, from more or less pure stands, and were constructed with the aid of Wolff von Wülfing's auxiliary tables.

52.43.4. STOTT, C. B., and RYAN, E. J. **A permanent sample plot technique adapted to commercial timber stands.** *Jnl. For.* 37, 1939 (347–9).

57.9 : 12.27.48 (922.1). HELLINGA, G. **Preliminary yield table for *Acacia decurrens* var. *mollis* Lindl.** *Tectona* 32, 1939 (277–89). [Du.e.]

The data for total clear bole volume and thick wood volume, for the preliminary table, have been derived from 62 surveys of sample plots, mainly in West Java. The rotation of the greatest volume was calculated at about 6 years for the highest and 7 years for the lowest site classes.

6. MANAGEMENT. WORKING PLANS. SURVEYS

6 (71.3). CAIN, W. C. **Forest management in Ontario.** *For. Chron.* 15, 1939 (16–28). Conf. ppr.

61.3 (57 : 47). Aviazija pri rabotach po planirovaniju i organisazii lesnovo chosjaistva. [**Aviation in the planning and organization of forests.**] Goslestechisdat, Leningrad. 1936. [R.]. pp. 224.

The Division of Forest Aviation at the Central Forestry Research Institute has prepared this publication dealing in six chapters with various aspects of the subject. It includes a description of the routine followed in the years 1933–5 when some 55,000,000 ha. of forest territory were surveyed in the northern regions of European Russia, Siberia, Kasakstan, and the Urals. The methods of survey are distinguished as follows according to the relative use made of aerial photography and ground work in obtaining the desired information: aerial photography supplemented by ground work, ground work supplemented by aerial reconnaissance, and the 'intermediate' method in which ground work and aerial work are of about equal importance.

The first method has its place in the early stages of management. The ground work generally consists of linear valuation surveys in which the lines are at least 4 km. apart. The preparation of volume and yield tables and the study of forest types is usually combined with the survey. A preliminary aerial reconnaissance serves as a guide to the approximate position of the valuation lines. As soon as these lines are established the strips of forest containing them are photographed so that ground work can proceed without delay. As a rule a combination of vertical and oblique photographs is taken with a multi-lens camera, the vertical scale being 1 : 15,000. From these photographs a preliminary scheme of 'categories' is prepared into which the various types of forest are grouped according to their characteristics as interpreted from the photographs. Usually, a separate preliminary 'category' is determined for each mixture of species, only those species being taken into account which represent 20 per cent. or more of the mixture, and for each age, density, and quality class respectively, three classes being distinguished in the case of each of these characteristics. The final tracing of valuation lines is then made so as to include a sufficient number of plots in each 'category'. The linear valuation surveys determine the forest type, composition, age, quality class, density, volume, &c., of the stands. The volume of readily exploitable crops is subdivided into groups based on commercial possibilities. The data are then systematized: all stands of practically identical character are grouped into final 'categories' each of which is represented by a separate file containing its description and a key of sample

photographs illustrating the crops to be found in that particular 'category'. These files provide the necessary material for the final stereoscopic interpretation and description of the area surveyed.

The second method, ground survey supplemented by aerial reconnaissance, is applied to forest where relatively intensive exploitation is foreseen for the near future. The ground work consists of linear valuation surveys in which the distance between the lines is usually not more than 1 km. Vertical aerial photographs are prepared of an average scale of 1 : 10,000, or 1 : 5,000 in the case of stands of varied character that are to be subjected to irregular fellings. The photographs are used for (*a*) laying out valuation lines, (*b*) locating exactly the crop contours plotted in the course of the ground survey, (*c*) determining the crop contours which are situated between the valuation lines, and (*d*) as an aid to the study of topography. Data on the content and nature of the stands are obtained from the ground work exclusively. This method can be used for forests that have been surveyed in the past. The photographs indicate areas in which essential changes have taken place since the last survey and are useful in planning the required ground work for such areas.

For the so-called 'intermediate' method of survey the valuation lines are established at intervals of 2 km., and vertical photographs are taken on a scale of 1 : 15,000. Data on the forest stands situated between the valuation lines are obtained from the photographs, a key of sample photographs being used wherever required.

7. ECONOMICS. VALUATION. FINANCE. PROFIT AND LOSS

7. GRØN, A. H. **Forest economics as a science, a branch of education, and a practice.** *Dansk. Skovf. Tids.* 2, 1939. (101–9). [Da.]

The classic theory of economics, based on a theoretical equilibrium between production and consumption, was essentially static. Modern theory, on the other hand, aims at understanding the change and interactions of factors that always prevent the actual attainment of such an equilibrium. Forest economics should keep pace with the times and should endeavour to bridge the gap between theory and practice. As a science, forest economics demands a knowledge of higher mathematics and access to more precise data: as a branch of education, its aim should be to teach foresters to think economically by continual reference to actual problems and practice: and as a practice itself, it should enable those in charge of forests to interpret their position and to understand as clearly as the knowledge of the time permits the economic consequences of their management.

7 (42). **Does forestry pay?** *Quar. Jnl. For.* 33, 1939 (19–21).

Income and expenditure accounts, for the years 1920 to 1937 inclusive, have been kept for a woodland estate of 147 acres, in the United Kingdom, which was increased to 200 acres in 1937. The annual net profit or loss is shown for each year as well as a detailed account of income and expenditure for three sample years, 1923, 1929, and 1936, for which the excess of income over expenditure is shown to be £257, £241, and £393 respectively.

7 (42). **Does forestry pay?** *Quar. Jnl. For.* 33, 1939 (100–4).

On an estate of 1,900 acres of woodlands in the United Kingdom, of which 1,300 acres are classed as being over 100 years old, the annual net income from fellings and by-products is estimated at nearly £1. 6*s.* per acre for each of the years 1927 to 1936. As rabbits are checked and natural regeneration is plentiful the felling is not considered excessive. Comprehensive tables are included.

7 (481). BØHMER, J. G. **Some criteria of the efficiency of forestry.** *Tidsskr. f. Skogbr.* 47, 1939 (37–52). [Nor.].

The efficiency of private forestry must be judged by two main standards: its profitability to the owner, and its service to the general public in providing work and raw materials. An examination of the economics of production in Norway leads the author to believe that these requirements are not seriously at variance in that country, since it appears that both private and public interests would be best served by raising pulpwood on a rotation of 60–80 years.

74 : 12.25.53 : 23.26.2. REYNOLDS, R. R. **Possible returns from planted Loblolly Pine.** *Jnl. For.* 37, 1939 (250–4).

9 (42). HILEY, W. E. **Forestry and international crisis.** *Quar. Jnl. For.* 33, 1939 (1–4).
The position of British forestry reviewed in the light of the crisis.

90. GENERAL PRINCIPLES OF FOREST POLICY. OBJECTS OF MANAGEMENT

90 (71.4). PORTER, E. **Forest policy programme for Quebec.** *For. Chron.* 15, 1939 (56–8). Conf. ppr.

90(73). COLLINGWOOD, G. H. **The elements of the national forestry programme.** Policy in the U.S.A. *Jnl. For.* 37, 1939 (83–7). Conf. ppr.

90 (77.8). KOEN, H. R. **Forestry problems of the Ozarks.** *Jnl. For.* 37, 1939 (168–73). Conf. ppr.

90 : 6 (47.42). MATHIESEN, A. Küsimusi metsakorralduse alalt. [**Questions of forest management.**] *Mitt. Lehr- u. Versuchsrev. Univ. Tartu.* No. 8. 1939 (121–38). [Esth.g.]
A commentary on Esthonian policy with particular reference to the forest management instructions of 1935.

91. BENEFICIAL EFFECTS AND ECONOMIC SIGNIFICANCE OF THE FOREST

91.3 : 11.63.1 : 96.2 : 11.2 (66 : 67). MOOR, H. W. **The influence of vegetation on climate in West Africa with particular reference to the protective aspects of forestry in the Gold Coast.** *Institute Paper* No. 17. Imperial Forestry Institute, Univ. of Oxford. 1939. pp. 15.
The increasing importance of the protective value of forests is recognized in Lord Hailey's definition of the functions of forestry in Africa. While wood production is usually the direct objective of forestry, 'forest influences' and their effect on environment are of vital importance, particularly in the protection of water supplies, and in influencing climatic conditions. Such indirect benefits from the forest must be recognized in any sound plan of forest management. The problem is to determine the extent and significance of these influences on a regional rather than local basis, and in the tropics more particularly the relation between vegetation and the water cycle. Forests have a dual function in regard to the presence and degree of available moisture—firstly they conserve rainfall by diverting and retaining it in the earth, and secondly by means of transpiration they 'pump' moisture from the soil into the atmosphere and eventually this is spread to the surrounding vegetation either in the form of rain or as a blanket of moisture which may be just as valuable in maintaining a balanced moisture relation. Tropical forests may change a dry wind into a rain-bearing wind—a matter of great importance during a critical dry period.
In planning the management of a protection forest it should be kept in mind that transpiration varies with species and that the proper manipulation of species may lead to a more satisfactory balance between income and output of moisture than would develop naturally. A decision must be made as to the type of protection forest needed, where it would be most effective, and the species most suitable for any particular set of conditions. Forests that are primarily for the conservation of moisture should include only species of relatively low transpiration during dry periods, and should be situated in the region of heavy rains to divert and hold the moisture in the soil. Forests that are to function primarily as moisture producers, and as protection against desiccation, should be developed as shelterbelts to the windward of the stand to be protected, or as a shade- and moisture-producing overstorey. Protective forests should be confined to areas of definite usefulness in this respect, and in most cases may be considered as potential production forests.

92. FOREST LAW. FOREST OFFICIALS

92 (43.91). BRAXATORIS, Z. **The right to cut forests.** *Erdészeti Lapok* 78, 1939 (175–81). [Hu. g.f.e.]
Under the Hungarian Forest Law of 1879 cutting was restricted in certain specified forests only. During the post-war timber shortage a further order was issued which forbade cutting without the previous consent of government forestry authorities. The restrictions have now been extended by the new law of 1935, which requires that all forests shall be managed under working plans. Small private estates of less than 11·5 ha. are exempted from some of the provisions of the law. Excess cuttings can be made only after approval by the Minister of Agriculture.

92 (43.91). MERENDI, A. **Hungarian forest legislation.** *Riv. For. Ital.* 1, 1939 (6–14). [It.]

The Hungarian forest law of 1 August 1935 is reviewed. It has ten sections, each concerned with one phase of forest policy: (1) Conservation and general treatment of woodlands, (2) indivisibility of forest property, (3) transportation of forest produce, (4) afforestation, (5) forest syndicates, (6) natural reserves, (7) organization of the Forest Service, (8) forest offences, (9) 'The Nation's Forests', and (10) measures for the period of transition. The new law establishes powerful State control over private forest property, especially with regard to utilization and grazing.

92 (73). LEWIS, E. A. **Laws relating to forestry, game conservation, flood control, and related subjects.** Supt. of Documents, Washington, D.C. 1938. pp. 141.

Legislation in the U.S.A.

92 : 94 (73). SILCOX, F. A. **A Federal plan for forest regulation within the democratic pattern.** Policy in the U.S.A. *Jnl. For.* 37, 1939 (116–19). Conf. ppr.

92 : 97 (67.5). HEYSE, T. **Rules relating to transfers and concessions of agricultural and forest lands in the Belgian Congo.** *Bull. agric. Congo Belge* 30, 1939 (30–62). [F.]

94. FOREST OWNERSHIP. FOREST ACQUISITION. FOREST ALIENATION

94 (73). GILLETT, C. A. **The co-operative approach in forestry.** *Jnl. For.* 37, 1939 (99–103).

As related to present American conditions.

94 (73). HAMMAR, C. H. **Extending public control and management of forest land without purchase.** *Jnl. For.* 37, 1939 (3–13).

It is suggested that the Government should purchase the control rather than the ownership of forest land. As the costs of acquiring the former would be much less, a larger area could be brought under Government management per unit of money spent. Alternatively, a system might be established under which forest land would be owned jointly by the Government on the one part, and by a co-operative body of private individuals on the other.

94.12 (73). BROWN, N. C. **Progress in community forests.** *Jnl. For.* 37, 1939 (25–8).

A brief review of progress made to date in the movement to establish community forests in America. It is estimated that there are already about 1,600 such forests in the initial or early stages of development with a total area of approximately 3½ million acres. The movement is being directed and guided generally by the State foresters.

94.3 (73). **Report of Committee on Private Forestry.** Presented at the annual meeting of the Society of American Foresters. *Jnl. For.* 37, 1939 (121–3). Conf. ppr.

97. RELATION OF THE FOREST TO AGRICULTURE, MOUNTAIN PASTURE, AND INDUSTRY

97 : 94 (77). SAWYER, L. E. **The farm forestry situation in the Central States.** *Jnl. For.* 37, 1939 (173–9). Conf. ppr.

98. THE STUDY OF THE TIMBER MARKET

98. 2–3 (43). MIHALYI, Z. **Market regulation of German forestry and timber economy.** *Erdészeti Lapok* 78, 1939 (140–63). [Hu. g.f.e.]

It is suggested that Hungary might benefit by adopting regulations similar to those that have governed German forestry and timber economy since 1933 and by creating an organization on the lines of the *Marktvereinigung*. The provision of adequate timber supplies is a difficult problem for Hungary, where forest land constitutes only 12·6 per cent. of the total land area.

BOOKS

7 : 94.3 (73). MARQUIS, R. W. **Economics of Private Forestry.** McGraw-Hill Publishing Co. Ltd., Aldwych House, London, W.C. 2. 1939. pp. 219.

Forestry involves so much of social economy that one cannot treat the Economics of Private Forestry without considering the national aspects of the problem. In fact Marquis's book consists mainly of a clear and very interesting account of American forest policy.

The author describes how, in the beginning, the forest was regarded as a nuisance, and considered to be inexhaustible. During the nineteenth century came the fear of a timber famine, accompanied by tree planting and the Arbor Day idea. The general opinion in America, however, was, and still is to a large extent, that only the State, the communities, or really big capitalists could manage forests to give a sustained yield, because forestry as a business was hopeless. Now there is no fear of a timber famine—the trouble is rather the decline in the demand for timber and the increasing use of substitutes.

The present forest problem in the U.S.A. is to bring about a continuous forest management, not only on publicly owned lands, but also in private forestry. Forestry has to be organized so that it pays not only to cut the wood but also to regenerate the forest and maintain production. There are many obstacles against such a development. Prices of timber and lumber, as raw material, are much more sensitive and variable than those of the finished products, and, to a very great extent are subject to speculation. However, according to statistics, the demand for lumber does not change regularly with high and low prices, at least over short periods of time. The lumbermen often have to liquidate their timber under pressure from fixed interests on debts, fixed taxes, and other overhead costs. These conditions will have to be changed, and the State should aid the lumber industry to organize for permanent operations. The author points out that a subsidy to forestry may be as well justified as one to agriculture, shipping, or air lines. The companies that are willing to start forestry on their lands, aiming at selection cutting and sustained yield, should get cheap money from the State, thus lowering their interest costs; they should be relieved from taxation, and should be able to buy timber from the State forests to fill the gap in their supply while the trees are growing.

Of course there will be need for a certain amount of State regulation of forestry practice on private lands, and co-operation between public and private forestry. The States, countries, and communities also need to develop and maintain a forestry practice of their own, on publicly owned lands.

Already much work has been done in the direction pointed out, and the new forestry movement is most advanced in the South, where the pulp industry stimulates development.

Marquis's book contains some interesting American statistics on forest growth, lumber prices, population, the use of forest products, &c. It gives a good orientation of actual developments in the forest policy of the United States at the present time. The movement towards permanent forestry operations on privately-owned lands is still very young, but an energetic policy might be able to change the conditions considerably in a short time.

SVEN PETRINI.

35 (42). DAVEY, R. **Marketing timber and other woodland products.** The Estates Gazette, Ltd., 33–5, Kirby Street, London, E.C. 1. 1939. pp. 108.

The marketing of home timbers is a vital question in many countries and particularly so in England, where the potential market is extensive and varied and where there is strong competition from foreign sources. The problem that faces many forest owners in selling their products is clearly and concisely presented in this small but useful book. Consideration is given to objections and criticisms that have been directed at home-grown timber by manufacturers, and it is believed that in many cases these can be overcome.

Markets that exist in this country are described briefly with the type and quality of wood that is required in each case for various products.

Among the factors to be considered in improving marketing conditions are (*a*) lower transportation costs, (*b*) knowledge of market values, (*c*) organization of supplies, (*d*) some control of the distribution of imported timber and props, (*e*) the value of wood preservatives in increasing the use of non-durable species, and (*f*) the growing of quality timber.

33.38. MAZODIER, B. Le carburant forestier: étude économique et générale en France et dans le monde. [**Motor fuel from the forest: an economic and general study of the position in France and the world.**] Dunod, 92 rue Bonaparte, Paris, 1939. pp. 265. [F.]

This book includes a detailed statement on the importance of producer-gas to the French national economy and an account of French, colonial, and foreign experience with wood gas.

23.21.6 (4). SCHENCK, C. A. Fremländische Wald- und Parkbäume. Erster Band: Klimasektionen und Urwaldbilder. [**Exotic forest and park trees. Vol. I: Climatic divisions and photographs of virgin forest.**] Paul Parey, Berlin. 1939. pp. 615. Zweiter Band: Die Nadelhölzer. [**Exotic forest and park trees. Vol. II: Conifers.**] Paul Parey, Berlin. 1939. pp. 645. Dritter Band: Die Laubhölzer. [**Exotic forest and park trees. Vol. III: Deciduous trees.**] Paul Parey, Berlin. 1939. pp. 640.

11.63.11. JACKS, G. V., and WHYTE, R. O. **The rape of the earth: a world survey of soil erosion.** Faber & Faber, Ltd., 24 Russell Square, London. 1939. pp. 313.

2 : 02.1 (54). CHAMPION, H. G., & TREVOR, SIR GERALD. **Manual of Indian silviculture: Pt. I:** General silviculture, and **Pt. II:** Silvicultural systems. Oxford University Press. 1938. pp. 374.

NOTES FROM ANNUAL REPORTS

Reports examined include: *Australia*: Annual Report of the Commonwealth Forestry Bureau for 1937. *Province of Bombay*: Annual Forest Administration Report, 1937–8. *British Guiana*: Report on the Forest Department for 1937. *British Honduras*: Report of the Forest Department for 1937. *Burma* (1): Report on Forest Administration in the Utilization Circle for the year ended 31st March 1938. *Burma* (2): Annual Report on Working Plans, Silviculture and Entomology for the year 1937–8. *Ceylon*: Administration Report of the Conservator of Forests for 1937. *Cyprus*: Annual Report of the Forest Administration for 1937. *Hong Kong*: Annual Report of the Superintendent, Botanical and Forestry Department, for 1937. *Jamaica*: Annual Report of the Lands Department for the year 1937. *Jammu and Kashmir*: Progress Report on Forest Administration for the Fasli year 1993–4 ending 30th Assuj 1994 [15th October 1937]. *Johore*: Report on Forest Administration for 1938. *Malaya*: Annual Report of the Forest Research Institute, Kepong, for 1938. *Mauritius*: Annual Report of the Forest Department for 1937. *Nigeria*: Annual Report on Forest Administration for the year 1937. *Punjab*: Progress Report on Forest Administration for the year 1937–8. *Seychelles*: Annual Report of the Department of Agriculture for 1937. *Sind*: Annual Administration Report of the Forest Department for the year 1937–8. *Uganda*: Annual Report on the Forest Department for the year ended 31st December 1938.

The numbers in brackets indicate the pages of the reports to which the annotations refer.

SILVICULTURE

Australia. In the Federal Capital Territory 810 acres were planted with Monterey Pine (1). Various strains of Monterey Pine have been recognized and have been reproduced by cuttings with great success (4–5).

Province of Bombay. Experimental sowing and planting of Hirda (*Terminalia chebula*), on laterite soil and under natural shade, resulted in a 60 per cent. survival of the transplants and a 15 per cent. survival of seedlings (39). Data based on the measurement of a series of experimental plots indicate that 12 ft. × 12 ft. spacing for plantation Teak is most satisfactory as affecting girth increment in the early years (40).

British Guiana. Shimiri Locust (*Hymenaea davisii*) does not bear transplanting well, but may prove suitable for reafforestation on loose sandy soil (2–3). Suppressed Greenheart (*Ocotea rodioei*) responds slowly to cultural treatment for the first three years (3).

British Honduras. Experimental sowings indicate that Banak (*Virola merendonis*) may readily be raised from seed. Mahogany saplings over 10 ft. high develop very slowly unless freed from competitive vegetation (4). Satisfactory germination of *Pinus caribaea* is obtained on fairly dry areas after dense grass is macheted down close to the ground (6).

Burma (2). In the Ataran Division the removal of weed species by charcoal burners has made possible the opening of stands preliminary to natural regeneration of Pyinkado (*Xylia dolabriformis*) without cost (47–8). In the Zigôn Division profuse regeneration, particularly of Lein (*Terminalia pyrifolia*) and Yon (*Anogeissus acuminata*) followed clear cutting to ground level (49). In South Toungoo it is noted that a heavy opening (50 per cent.) of the stand and burning is followed by the establishment of plentiful regeneration of Pyinkado (49–50). Experiments in underplanting with Myankchaw (*Homalium tomentosum*) indicate that survival is favoured by the presence of undergrowth (81). Broadcasting experiments of Teak seed under natural forest conditions show that in general germination does not take place until the second rains (86).

Ceylon. The mixture of 75 per cent. *Eucalyptus robusta* and 25 per cent. *E. microcorys*, *E. citriodora*, and *E. maculata* has proved satisfactory in experimental planting of the Dry Patana Grasslands of the Province of Uva (10–11). The regeneration of Hora, both artificial and natural, following the clearing of undergrowth and regeneration fellings, is giving satisfactory results (11).

Cyprus. Apparently as the result of a greater root development, autumn regeneration survives the drought season much better than does spring regeneration (16).

Hong Kong. *Pinus massoniana* is considered a valuable pioneer plant (3). *Melaleuca leucadendron* L. has been found valuable for planting on particularly moist sites (4).

Jamaica. *Pinus massoniana* grows well but does not bear fertile seed in Jamaica (7). Records from

plantations indicate that the following species grow exceptionally well: *Pinus palustris*, *P. massoniana*, *Araucaria excelsa*, *Podocarpus elongatus*, *Grevillea robusta*, *Acacia dealbata*, *Eucalyptus globulus*, *E. citriodora*, *Cryptomeria japonica* (8).

Jammu and Kashmir. Dense weed growth and sudden isolation of seed trees following heavy opening of the canopy are thought to be the causes of slow natural regeneration of Deodar and Kail (*Pinus excelsa*) (14). Light grazing is found to be beneficial to the natural regeneration of Chir (15).

Johore. In forests that are predominantly Kapur (*Dryobalanops aromatica*) a seeding felling results in complete regeneration of good quality, whereas forests containing a large percentage of Meranti (*Shorea* spp.) require pre-treatment before the seeding felling (8).

Malaya. The 'wrenching' of Keladan (*Dryobalanops aromatica*) seedlings is found to be more satisfactory than transplanting. This operation consists in undercutting the seedlings with a sharp trowel 2 to 3 in. below ground surface, slightly raising the plants and leaving them in this position for a few months to develop bushy roots (2). Soaking in hot water at 100° F. and scarifying with a rough file appear to be successful methods for accelerating the germination of the seed of Merbau (*Afzelia bakeri*) (2). Weeds such as Malayalam (*Eupatorium odoratum*), Lakum (*Vitis* spp.) and Selupat Tunggal (*Mikania cordata*) will probably disappear in the course of natural succession (4).

Mauritius. *Pinus taeda* and *P. caribaea* grow well in plantations (8). Overwood protection is essential to the proper development of *Tabebuia* sp. (12). Cuttings and rootsuckers of *Populus canescens* and *P. deltoidea* have been planted experimentally (13).

Nigeria. An exotic, *Azadirachta indica*, regenerates naturally under heavy shade. Coppicing of the slow-growing species *Daniellia oliveri*, *Parinarium curatellaefolium*, *Butyrospermum parkii* and *Detarium senegalense* have been successful (5). The use of ground-nuts when sowing *Cassia siamea* at stake results in a relatively high survival and strength of plant. The planting of guinea corn with *Eucalyptus rostrata* gives similar results (6). The use of 'dry' nurseries for growing stock has resulted in increased yield and reduced costs (7). Cultivation of natural regeneration of Iroko (*Chlorophora excelsa*) in the mixed deciduous forest belt is considered preferable to artificial methods. Cultivation in this case includes opening the stand and turning the soil through intensive exploitation (9). Iroko regeneration is often found under the secondary growth of *Solanum torvum* (12).

Punjab. Regeneration of Fir is poor after shelterwood felling, but abundant in the shade of other species left after selection cutting (16).

Sind. The irrigation of plantations on high-lying areas, by pumping water from an adjacent river, is proving valuable in the Riverain Forest of Sonabindi in Larkana Division (28).

Uganda. Stripped plants of Mahogany and Iroko, 5 to 6 ft. high, may be transplanted during the resting stage without any bad effect (11). Complete hoeing at time of planting and keeping the soil in a hoed condition until tree canopy is formed, is found to be cheaper than spot hoeing and weeding in afforesting poor quality land with *Eucalyptus robusta*, *E. rostrata*, *Cassia siamea*, and *Casuarina equisetifolia* (11). *Mimosa bracatinga*, a native of Brazil, grew up to 12 ft. in height in one year after sowing at stake (12). Using various concentrations of arsenite of soda in aqueous solution, in a frill-poisoning experiment, the following results, in percentages of living trees related to pounds of arsenite of soda per gallon of water, were obtained after 15 months: 2 pounds–31 per cent., 1 pound–39 per cent., ½ pound–50 per cent., control with frill and no poison–95 per cent. (12).

EXTRACTION, UTILIZATION, AND MARKETING

British Guiana. The use of lorries and the possible use of tractors for hauling logs is extending the area of exploitable forest considerably (2). Local firms are seasoning Habuballi (*Loxopterygium sagoti*) for furniture manufacture (5). The species *Carapa guianensis* is to be known on the market in the future as Empire Andiroba (5). A beginning has been made in the export of Wallaba (*Eperua* spp.) charcoal to the United Kingdom (6).

British Honduras. Increased use is being made of motor trucks and trailer transport for Mahogany from the Crown Lands on the west (10). *Pinus caribaea* is heavier and has superior strength qualities than average commercial Slash Pine (10–11).

Burma (1). Preliminary tests indicate improvement in the kiln-drying of Yon (*Anogeissus acuminata*), both in time and quality, by steeping the wood in a saturated solution of sodium chloride at 160° F. for 38 hours before drying (10). Tests of end-coating of timber as a preservative measure

indicate that the effect of such treatment is increased when the logs are placed in the shade and protected from rain. No preparation was found to be effective against weathering (12).

Burma (2). Utilization tests indicate that the species Aridda (*Campnosperma zeylanica*), Kekuna (*Canarium zeylanicum*), Kirihembiliya (*Palaquium petiolare*), and *Alstonia macrophylla* are suitable for match-making (15).

Cyprus. The total volume, over bark, of timber cut from State forests in 1937 amounted to 863,520 cu. ft. and was all consumed within the colony (12). The grading of certain mining timbers was put into force (14).

Jammu and Kashmir. The timber market in northern India has been stabilized to some extent through control of the exploitation of the forests of Kashmir (13). A large part of the Fir forests of the Kashmir Circle are to be worked for pulpwood (14).

Johore. Matches are manufactured almost exclusively from Terentang (*Campnosperma auriculata*) in a local factory (10).

Malaya. Specific gravity measurements show that plantation material of the species Meranti tembaga (*Shorea leprosula*) is heavier and stronger than forest-grown timber of the same size (15). Untreated wood of Teak, Billian, and Greenheart, after three years' exposure to marine borers, was either very badly attacked or destroyed (19).

Mauritius. The match industry takes most of the annual cut of Pine (*Pinus massoniana*), which totalled 21,392 cu. ft. (13, 14, 18).

Nigeria. Most of the common secondary indigenous timbers are non-durable and require preservative treatment (17).

Sind. Preliminary tests of native grasses as a source of paper pulp gave the following results:

Species	*Unbleached yield per cent.*	*Bleaching powder per cent.*	*Bleached yield per cent.*
Saccharum spontaneum . .	37·2	2·95	33·0
S. arundinaceum (reeds) . .	39·9	2·70	37·3
S. arundinaceum (leaves) . .	26·8	2·70	22·0

S. arundinaceum appears to give a somewhat higher quality pulp (19).

Uganda. After 30 months in a testing 'graveyard', untreated pieces of the following species remain unaffected by either termites or fungi: *Cynometra alexandri*, *Chlorophora excelsa*, *Albizzia coriaria*, and *Mildbraediodendron excelsum* (13). A piece of the last-named species remains entirely sound after part submergence in fresh water for 2½ years (13).

PROTECTION

Burma (2). *Gmelina arborea* is the host of a number of the pests of Teak including the beehole borer (*Xyleutes ceramica*) and should not be associated with Teak in regeneration projects. Temperature is the vital factor determining the rate of hatching and survival of eggs of *Xyleutes ceramica*. At critical temperatures, humidity, age of eggs, and other factors have some control. Larvae may survive without food for six days after hatching, though young larvae are more vulnerable to adverse conditions than are eggs (97–9). Tests have been made with some parasites of defoliators of Teak, and the parasite *Cedria paradoxa* has been bred successfully (101–2).

Cyprus. The processionary moth (*Thaumetepoea wilkinsoni*, Tams) and various wood and bark borers are the insects causing most damage to Cyprus forests (8). Grazing is one of the main factors retarding reafforestation and the Government is beginning to cancel certain forest grazing rights as a step to the solution of this problem (8).

Hong Kong. Incidence of the Pine tree caterpillar (*Dendrolimus punctatus*) has been slight for the third successive year (4).

Nigeria. Mahogany has been attacked by a large longicorn beetle (*Totloes* sp.) and a moth caterpillar (4–5). *Eucalyptus torelliana* was attacked by termites though previously thought to be immune (5).

Punjab. 70 per cent. of a plantation of 24,000 Agaves were destroyed by porcupines (9). Considerable damage was done by the defoliator *Plecoptera reflexa* which builds up a population in areas

of poorly growing Shisham (*Dalbergia sissoo*) (9–10). The fungus *Fomes annosus* kills Deodar saplings particularly when growing in mixtures with Spruce or in areas that formerly bore pure Kail (*Pinus excelsa*) crops (11). The incidence of the fungus *Trametes pini* in Kail forests is increased with the practice of lopping (11). A heavy growth of grass and the appearance of indigenous tree and shrub species has resulted from experimental protection of eroded areas from grazing (15).

Seychelles. The attack of the green scale *Lecanium viride* on Excelsa Coffee trees has been brought under control through the use of a species of predator (*Exochomus ventralis*) (17).

Sind. The main current of a flooding river appears to have been diverted from the eroding bank by tying a large number of freshly felled heavy Babul and Kandi trees, with crowns intact, to the bank (32).

ECONOMICS, MANAGEMENT, AND POLICY

British Honduras. Approximately 940 miles of land and river traverses were completed. A two-hour flight over the Cayo District added considerable information on land and forest conditions (2, 13–14). A serious shortage of accessible, merchantable mahogany has resulted in trespassing and the cutting of undersized wood (8). The value of exports of all forest produce for 1937 amounted to $953,197.00, Mahogany and Cedar totalling $734,880.00 (10).

Jamaica. The organization of a new Forest Branch of the Lands Department was started and a new comprehensive Forest Law relating to protection and management of forests came into effect (4, 8, 9). A start was made in the formation of small village forests (6).

Mauritius. The system of leases for planting *Casuarina* in the coastal strip was revised (9).

Nigeria. A new Forest Ordinance came into effect on 1st February 1938 (1).

Uganda. Native Forest Reserves are now being selected as authorized by a recent amendment of the Forests Ordinance. These will be maintained and controlled by Native Administration (6–7). Each tax-payer in Kigezi is expected to plant 25 trees a year and an order has been issued recently, by the Mukama of Toro, that each of his subjects do likewise (12).

LIST OF ABBREVIATIONS

Act. For. Fenn.	Acta Forestalia Fennica. Helsinki.
Algeria Stn. Rech. For. Bull.	Algiers Station: Recherches Forestières du Nord de l'Afrique, Bulletins. Algiers.
Allg. F. u. J.	Allgemeine Forst- und Jagd-Zeitung. Frankfurt.
Am. Forests	American Forests. Washington.
Ann. Éc. Nat. E. & F. Nancy	Annales de l'École Nationale des Eaux et Forêts. Nancy.
Austral. Cw. For. Bull.	Australia Commonwealth Forestry Bureau Bulletins. Canberra.
Austral. For.	Australian Forestry. Perth, W. A.
Bull. agric. Congo Belge	Bulletin agricole du Congo Belge. Brussels.
Bull. cercle zool. congo.	Bulletin du Cercle zoologique Congolais. Ganda.
Bull. Com. For. Paris	Bulletin du Comité des Forêts. Paris.
Bull. écon. Indochine	Bulletin économique de l'Indochine. Hanoï-Haiphong.
Bull. Imp. Inst.	Bulletin of the Imperial Institute. London.
Bull. S. Fr.-Comté	Bulletin de la Société forestière de Franche-Comté. Besançon.
Centralbl. f. d. g. Forstw.	Centralblatt für das gesamte Forstwesen. Vienna.
Contrib. Boyce Thompson Inst.	Contributions. Boyce Thompson Institute for Plant Research. Menasha, Wisconsin.
Deutscher Forstv. Jahresb.	Deutscher Forstverein. Jahresberichte. Berlin.
Ecol. Mon.	Ecological Monographs. Durham, N.C.
Emp. For. Jnl.	Empire Forestry Journal. London.
For. Chron.	Forestry Chronicle. Toronto.
Forst. Forsøgsv. Dan.	Det forstlige Forsøgsvaesen i Danmark. Copenhagen.
Forstw. Centralbl.	Forstwissenschaftliches Centralblatt. Berlin.
Ind. Engng. Chem.	Industrial and Engineering Chemistry. Easton, Pa.
Ind. For.	Indian Forester. Lahore.
Inst. Rech. For. Poland Trav. & Comptes Rendus	Institut de Recherches des Forêts Domaniales: Travaux et Comptes Rendus. Warsaw.
Int. Rev. Timber Util.	International Review on Timber Utilization. Brussels.
Jnl. Arn. Arb.	Journal of the Arnold Arboretum. Lancaster, Pa.
Jnl. Ecol.	Journal of Ecology. London.
Jnl. For.	Journal of Forestry. Washington.

Jnl. for. suisse	Journal forestier suisse. Berne.
Jnl. Land Agents' Soc.	Journal of the Land Agents' Society. London.
Jnl. R.R.I. Mal.	Journal of the Rubber Research Institute of Malaya. Kuala Lumpur.
Jnl. R. Soc. Arts	Journal of the Royal Society of Arts. London.
Jnl. S.A. For. Assn.	Journal of the South African Forestry Association. Pretoria.
Mal. For.	Malayan Forester. Kuala Lumpur.
Mich. Agric. Expt. Sta. Quart. Bull.	Michigan Agricultural Experiment Station Quarterly Bulletin. East Lansing, Michigan.
Mitt. Forstwirt.	Mitteilungen aus der Forstwirtschaft und Forstwissenschaft. Hannover.
Mitt. Forstw. Abt. Tartu Estonia	Mitteilungen der Forstwissenschaftlichen Abteilung der Universität Tartu. Tartu.
Mittg. d. Dendr. Ges.	Mitteilungen der Deutschen Dendrologischen Gesellschaft. Bonn-Poppelsdorf.
Mitt. Lehr- u. Versuchsrev. Univ. Tartu	Mitteilungen des Lehr- und Versuchsreviers der Universität Tartu. Tartu.
Mitt. Schw. Anst. forstl. Versuchsw.	Mitteilungen der Schweizerischen Anstalt für das forstliche Versuchswesen. Zürich.
Nachrichtenbl. f. d. Pflanz.	Nachrichtenblatt für den deutschen Pflanzenschutzdienst. Berlin.
N. Z. Jnl. For.	New Zealand Journal of Forestry. Wellington.
Ochr. Rostl.	Ochrana Rostlin. Prague.
Philip. Jnl. For.	Philippines Journal of Forestry. Manila.
Quart. Jnl. For.	Quarterly Journal of Forestry. London.
Queensland Agric. Jnl.	Queensland Agricultural Journal. Brisbane.
Rev. E. & F.	Revue des Eaux et Forêts. Paris.
Rev. int. du Bois	Revue Internationale du Bois. Paris.
Rev. int. prod. col.	Revue internationale des produits coloniaux. Paris.
Rev. Padur.	Revista Padurilor. Bucharest.
Rev. Soc. Arg. Cienc. Nat.	Revista de la Sociedad Argentina de Ciencias Naturales.
Riv. For. Ital.	La Rivista Forestale Italiana. Rome.
Roy. Canad. Inst. Trans.	Transactions of the Royal Canadian Institute.
Sborn. Čsl. Akad. Zeměd.	Sbornik Ceskoslovenske Akademe Zemědělské. Prague.
Schweiz. Zeitschr. Forstw.	Schweizerische Zeitschrift für Forstwesen. Bern.
Scot. For. Jnl.	Scottish Forestry Journal. Edinburgh.
Silva Fenn.	Silva Fennica. Helsinki.
Sven. Sk. Tids.	Svenska Skogsvardföreningens Tidskrift. Stockholm.
Thar. For. Jahrb.	Tharandter forstliches Jahrbuch. Berlin.
Trop. Agric.	Tropical Agriculture. Trinidad.
Trop. Woods.	Tropical Woods. Yale, New Haven, Conn.
T. T. Jnl.	Timber Trades Journal. London.
Zeitschr. F. u. J.	Zeitschrift für Forst- und Jagdwesen. Berlin.
Zeitschr. f. angew. Entom.	Zeitschrift für angewandte Entomologie. Berlin.
Zeitschr. f. Weltf.	Zeitschrift für Weltforstwirtschaft. Neudamm.